

GENERAL LIBRARY
MAR 20 1920
UN. OF MICH.

PUBLIC WORKS.

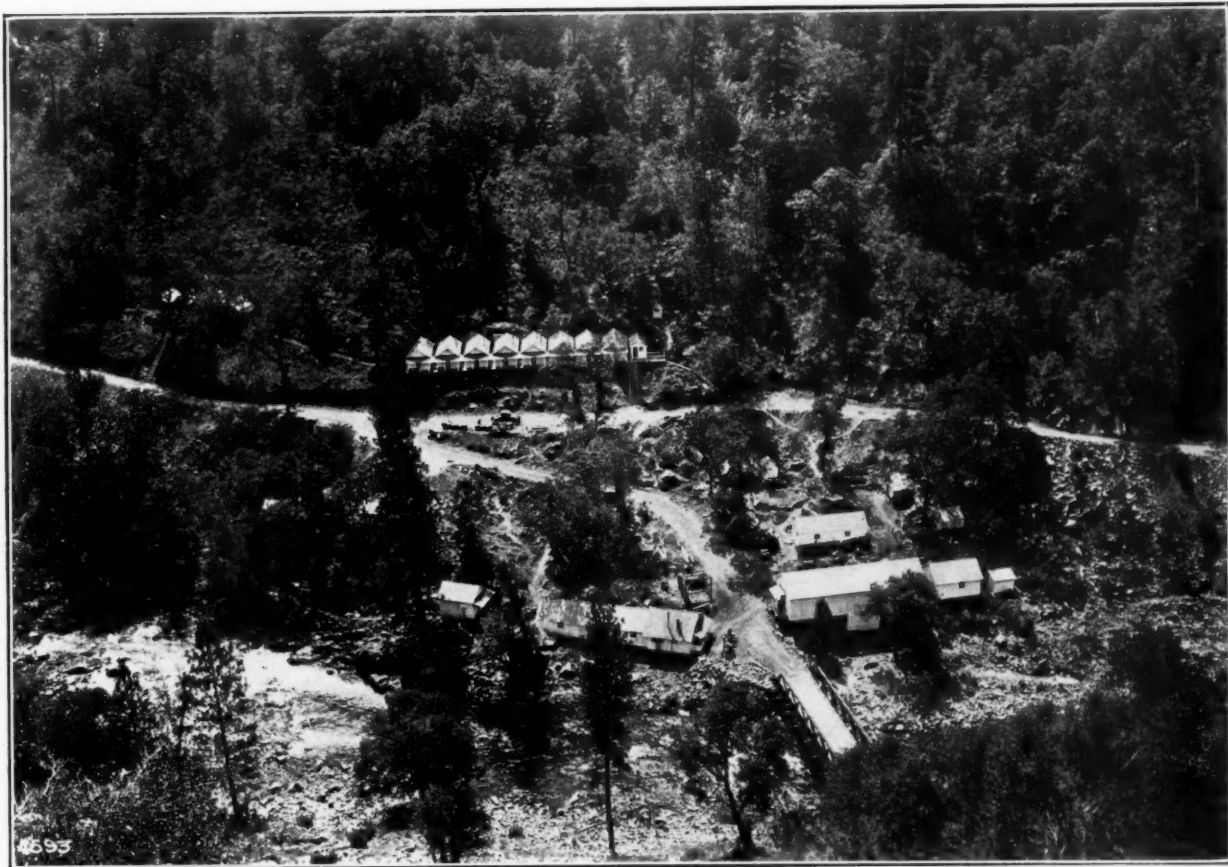
CITY

COUNTY

STATE

A COMBINATION OF

"MUNICIPAL JOURNAL & PUBLIC WORKS" and "CONTRACTING"



CONSTRUCTION CAMP ESTABLISHED IN THE TUOLUMNE RIVER VALLEY FOR WORKMEN
EMPLOYED ON \$45,000,000 HETCH-HETCHY WATER SUPPLY

In This Issue

Hetch-Hetchy Water Supply—II

Contractors' Percentage Fees and Estimate Charges

State Highway Construction

Newark Sewer Tunnel

NEW YORK, MARCH 20, 1920

Speaking of **CONCRETE ROADS STREETS and ALLEYS**

53,000,000 Square Yards
Were Placed Under
Contract During 1919—

Over twice that of any previous year. Every state—your state—contributed to this total. Public preference is expressed in this record. Watch 1920!

Concrete highways defy the poundings of traffic year in and year out. They won't blow away during dry weather, won't wash away in wet weather. Let weather and season change—the road won't—for any day, any season is just the same to a concrete road. It's not what they cost to build but the little they cost to maintain that makes concrete pavements economical.

People know what they want and ask for it—**concrete**—a dollar of value for every dollar that they are so generously investing in improved highways.

PORTLAND CEMENT ASSOCIATION

Atlanta
Chicago
Dallas
Denver
Des Moines

Detroit
Helena
Indianapolis
Kansas City
Los Angeles

Milwaukee
Minneapolis
New York
Parkersburg
Pittsburgh

Salt Lake City
Seattle
St. Louis
Washington

PUBLIC WORKS.

CITY

COUNTY

STATE

A Combination of "MUNICIPAL JOURNAL AND PUBLIC WORKS" and "CONTRACTING"

Vol. 48

NEW YORK, MARCH 20, 1920

No. 10

Hetch Hetchy Water Supply* II

Early Intake power station provides 4,000 hydro-electric horsepower for construction operations at an initial cost of nearly \$690,000, exclusive of transmission line and operation. The \$283,000 concrete dam, 70 feet high, contains over 11,000 yards of concrete, distributed by a combination of cable cars and spouting system. The aqueduct canal, 1 mile long, was concreted from an overhead traveling platform. About 1½ miles of temporary wooden flume, with a minimum section of 5 x 6½ feet, contain 1,300,000 feet of lumber, and will ultimately be replaced by rock tunnels. A mile of rock tunnels have already been driven for the present service. The three large turbines are each supplied by a 42-inch steel penstock under 345.5 head, secured by heavy concrete anchorage foundations.

Supplementary to the construction of the main storage dam and aqueduct at a cost of \$45,000,000 for the delivery to San Francisco of an immediate supply of probably 600,000,000 gallons of water per day from a watershed 150 miles distant in the Sierra Nevada mountains, there was established a preliminary hydro-electric power plant at a critical point on the line of the aqueduct to supply a large amount of power for construction purposes.

The power station, located at the east end of the main tunnel at the point marked Early Intake on the topographical sketch published in the Municipal Journal, Vol. 45, page 224, Sept. 21, 1918, is operated under a head of 346 feet to supply 4,000 h.p. for the operation of construction plant at the Hetch Hetchy dam 12 miles above on the Tuolumne River, and for the excavation of the main tunnel 18.3 miles long, extending from the power station to the reservoir at Priest.

The water operating the turbines is derived from

* Part I.—154-mile aqueduct and auxiliaries for ultimate delivery of 400,000,000-gallon daily to San Francisco at estimated cost of \$45,000,000. Preliminary work, \$2,000,000, including construction of \$2,000,000 railroad, 68 miles long. Public Works, March 6; page 165.

the Eleanor Reservoir formed by the construction of an impounding dam 62 feet high above steam bed that was built across the Eleanor creek 12 miles from the power station where the bed of the creek is 2,347 feet above the power station, thus providing a very steep slope for the rapid flow through the natural bed of the creek and of the Cherry

River into which it empties. About 3.5 miles from the power station, a diversion dam built across the bed of the river turns its water into a concrete lined aqueduct canal, connecting that point with the head of the steel penstock 550 feet long that delivers to the turbines. Both the storage dam and the aqueduct, although built for construction purposes are so designed as to be retained for future service in an auxiliary



CONSTRUCTING 44-FOOT SPAN INCLINED CONCRETE ARCHES OF ELEANOR DAM.

supply to the permanent aqueduct that will be provided by enlarging the dam and creating a great reservoir to increase the regular city water supply.

IMPOUNDING DAM.

The impounding dam 70 feet high from the lower part of the foundation to the crest, is of the multiple arch type and cost about \$283,000. The total length of 800 feet of the 40 arches comprising the

main part of the dam is extended to 1,260 feet by a low concrete wing wall at each end. It has a storage capacity of 8,700,000,000 gallons, sufficient to insure, during the dry season, supply for the power house.

The dam is located on the site selected for a storage dam capable of raising the lake level 100 feet or more when it is necessary to supplement the city water supply to be derived at first from the Hetch Hetchy reservoir. The present dam will remain in position ready to be incorporated in the structure of the future high dam.

DAM CONSTRUCTION.

The first preliminary for building the Eleanor Dam was the construction of 14 miles of wagon road from the dam site to the terminus of the Hetch Hetchy Railroad. This steep and crooked highway is built largely in granite cuts with thirteen switchbacks, most of them requiring several reversals of an automobile truck. In $3\frac{1}{2}$ miles it rises to an altitude of 1,800 feet above the valley floor level, with almost continuous grades of $12\frac{1}{2}$ per cent.

During the construction of the highway a saw-mill was erected on Eleanor Creek half a mile

operated by a single-drum hoisting engine that spotted them in the required positions to deliver to chutes conveying the concrete to all parts of the dam, which was below the service track.

Concreting was commenced in November and special efforts were made to get enough concrete placed before snowfall to enable construction to proceed in the following spring without interference from the usual flood. The concrete was built to a sufficient elevation to provide for six temporary sluiceways before operations were discontinued for the winter December 22. They were resumed on April 22 and the dam was completed in a little more than a year after excavation was commenced.

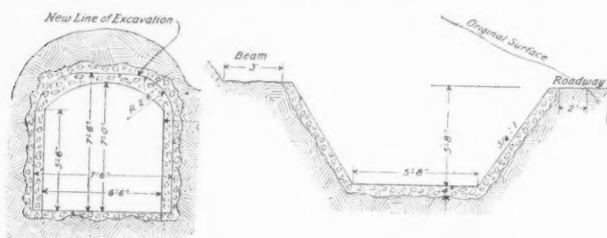
The 20 main arches of 44-foot span and their buttresses were concreted in wooden forms that, at the beginning followed closely after the excavation. As the work progressed, the forms, in sections 10 feet high, were supported on the heavy falsework trestle built in 20-foot stories as the work progressed. About 11,650 yards of concrete and 262,000 pounds of reinforcement steel were required for the dam, and the concrete was placed at an average rate of about 100 yards per 8-hour shift, although a maximum of 130 yards was made.

The storage reservoir created by the dam has a capacity of 26,700 acre feet, an amount which is so much less than the total runoff of the watershed that it is filled early in the season. The cost of the dam was \$283,000. It was designed under the direction of city engineer, M. M. O'Shaughnessy by R. P. McIntosh, hydraulic engineer assisted by R. J. Wood, structural engineer. Frank J. Boothe was resident engineer of construction.

The water from the Eleanor Reservoir is conveyed about 8 miles through the Cherry River to a point where the channel of the latter is crossed by a concrete diversion dam deflecting the flow into the aqueduct. This dam which is built on the rock bottom of the river is only about 6 feet high and 140 feet long, with a gravity cross section and was built without forms. It contains about 80 yards of cyclopean concrete and was built in 15 days at a cost of about \$1,500.

AQUEDUCT.

The aqueduct from the diversion dam to the power house has a capacity of 200 second-feet and consists of nearly equal lengths of wooden flume, open concrete lined canal, and partly lined tunnels. As it is located on a steep hillside, there was no



LINED SECTION OF CHERRY RIVER AQUEDUCT TUNNEL

CANAL AQUEDUCT FOR CHERRY RIVER HYDRO-ELECTRIC DEVELOPMENT.

above the dam site, and during the first six months produced 900,000 feet of lumber for use in the construction of the dam and its appurtenances.

Cement was hauled from the railroad by a fleet of 12 automobile trucks working two or three 8-hour shifts daily as necessary to transport the 70,000 bags required and maintain a considerable storage at the dam.

Excavation for the foundation was carried on with hand derricks and was made several feet below the bed of the stream in order to avoid danger from seams in the granite stratum. The foundations for the arches and buttresses were carried down from 5 to 15 feet below the surface.

The cost of the cement, delivered on the Sierra Railroad was \$2.67 per barrel. The additional charge of $11\frac{1}{4}$ cents per bag for double sacking it and the cost of trucking amounted to about 90 cents per bag for transportation.

CONCRETING.

Concrete was made of broken stone, sand and gravel. The sand and gravel were hauled by Fresno scrapers to depressed hoppers from which they were passed through screens to large storage bins that delivered by gravity to narrow gage side dump cars running down an incline to serve the 1-yard Foote mixer installed above the crest of the dam.

From the mixer, the concrete was spouted to 1-yard bottom dump cars hauled by an endless rope



PORTAL OF CHERRY RIVER AQUEDUCT ROCK TUNNEL.

opportunity at the lower end for the construction of a forebay reservoir, so the flume there was enlarged to about three times its normal capacity for a length of more than 2,000 feet just above the power house, to provide storage enough to carry the plant over minor fluctuations of load.

There is one mile of open canal excavated in rock and earth with depths equal to the bottom widths and concrete lining with an average thickness of 6 inches. It is located on the hydraulic slope of 0.001 and is constructed with a 3-foot berm on the uphill side and roadway embankment beyond the 2-foot berm on the downhill side.

The excavation was made with pick and shovel and with drilling and blasting where necessary, and the side slopes were trimmed smooth to receive the concrete that was maintained on the sloping surface by wooden forms braced across the width of the canal. Concrete was mixed in a steam-driven two-bag batch machine mounted on a traveling platform that spanned the canal and advanced as the work progressed. Broken stone and cement were delivered by motor trucks alongside the canal and were brought in wheelbarrows from the storage pile to the mixer. The side walls were concreted in alternate 8-foot sections, after which the concrete mixer returned a maximum distance of 200 feet, and concreted the intermediate sections separated by roofing paper expansion joints. The floor slab was concreted last.

FLUMES.

On very precipitous slopes where the cost of excavation for the concreted canals would have been prohibitory, wooden flumes were built with an aggregate length of about 1 mile. It is intended, however, when labor and supplies are more abundant, to replace the flumes with tunnels that can be built and put in service without interrupting the use of the power plant.

Two of the flumes have a 5 x 6½-foot cross section while the storage flume has a 9 x 10-foot cross section. The flumes are supported either on mud sills or on short trestle bents with projecting caps to which the vertical posts in the side walls are knee-braced.

Excavation for the footings of the fills and trestle bents were carried down to solid rock, the supports built after the permanent floor of the flume was laid on them, a wooden rail track was installed

there on which were operated push cars delivering lumber for the sides of the flume. There was used in all 1,800,000 feet of lumber which was manufactured at the City's sawmill and transported by train and automobile trucks to the canal line.

TUNNELS.

The tunnels, of the same capacity as the canal, have an aggregate length of 1 mile and were excavated with a rectangular cross-section, having a neat height and width of 7 feet 6 inches. The rock bottom is exposed throughout and the sides and roofs are lined with concrete only when necessary to support the rock.

The total excavation of the five short tunnels in this line aggregated about 12,500 yards. About 3,950 feet of the tunnels were constructed for a contract price of \$47,530 by the McArthur



TRAVELING MIXER PLATFORM FOR CONCRETING CHERRY RIVER AQUEDUCT CANAL.

Brothers, New York and Chicago. The balance of the excavation and all of the lining was done by the city's forces.

PENSTOCKS AND POWER PLANT.

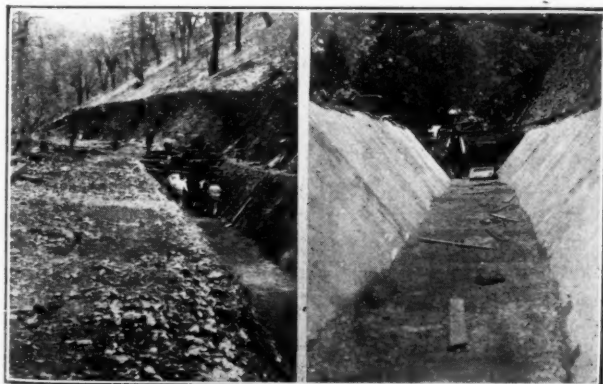
Water is delivered from the lower end of the flume to the turbine through a 42-inch penstock 530 feet long made of riveted steel plates from 3/16-inch to 3/8-inch thick. The pipe was furnished and put in place by the Western Pipe & Steel Co. for a contract price of \$7,558. It was installed in a ditch excavated in a hillside so steep that it was necessary to provide for it very heavy concrete anchorages at the foot of the hill just above the power house and at the vertical bends in the line.

In the temporary steel-concrete power house, there are installed three Francis turbines operating at 720 R. P. M. and each direct connected to a 2,300-volt, 3-phase, 60-cycle generator with direct connected exciter. The voltage is stepped up through a single bank of transformers to 22,000 volts for transmission to the sub stations located along the 19 miles of aqueduct to the west and to the main Hetchy dam site 12 miles east of the power plant.

In designing the plant it was intended that the estimated full load of 2,00 K. W. should be carried on two machines, allowing the third unit to be held in reserve.

REVENUE FROM POWER.

A connecting line 4,500 feet in length was built from the end of the City's transmission line to the Sierra Company's line and on September 21, 1918,



EXCAVATING CHERRY RIVER AQUEDUCT CANAL.

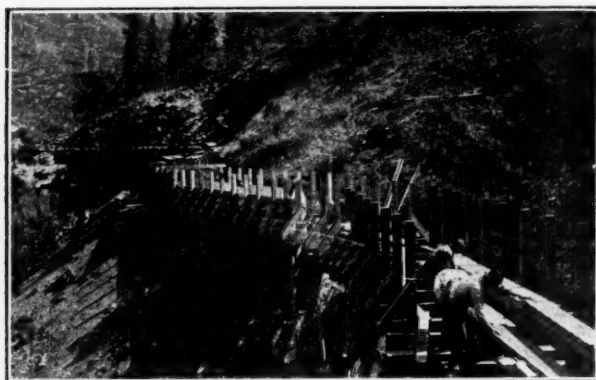
CONCRETING CHERRY RIVER AQUEDUCT CANAL.

the City commenced delivering all its surplus power to the company. Between the time when connection was made and July 1, 1919, the city earned from the sale of power a gross income of \$67,528.10.

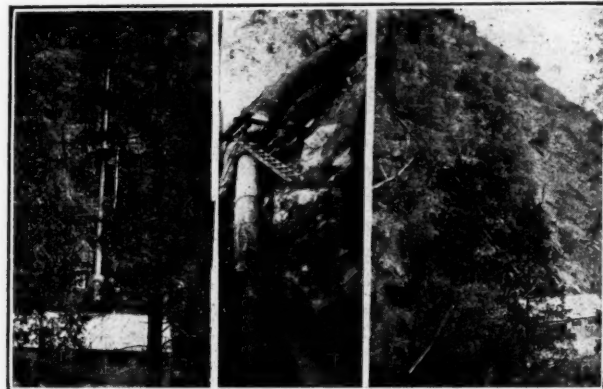
During the fiscal year 1918-1919 the plant generated 18,687,400 K. W. H., of which 13,505,621 have been sold and the remainder, 5,181,779, covers use at the plant, use on the city's work, and line and transmission losses. Five step-down transformer sub-stations are operated, three at tunnel portals and two at shafts, ranging in capacity from

locality on the river bank as seen in the general view on the front cover, where the building nearest the river is cook house and dining room. Across the road from this building is a large storehouse and at its right, is a bath house where hot and cold showers were installed. All of the other buildings are bunk houses.

The camp is kept scrupulously clean and in good sanitary condition and the meals here as in all of the other camps of the Hetch Hetchy Water Supply are so excellent and the conditions so desirable, that



CONSTRUCTING TEMPORARY SIDE HILL WOODEN FLUME FOR CHERRY RIVER AQUEDUCT.



STEEL PENSTOCK FOR EARLY INTAKE HYDRO-ELECTRIC PLANT, INSTALLED ON STEEP SLOPE

100 to 300 K. V. A. In addition each of these sub-stations is equipped with one 10 K. V. A. transformer to supply current for lighting. All of the power current is being used at 440 volts, 3 phase, while lighting current is single phase 110-220 volts.

With a light winter rainfall in 1918-1919 it was necessary to use stored water from the reservoir until February 3, since which time the run-off has filled the reservoir at Lake Eleanor.

COST AND INSTALLATION OF EQUIPMENT.

The hydraulic machinery for the power house was furnished by the Pelton Water Wheel Co., for a contract price of \$18,814. The electrical generators and excitors were furnished and delivered for \$7,700 by the Westinghouse Electric Mfg. Co. There were four machines of the outdoor type, all insulated, water cooled and provided with oil filters.

The transmission line extends 19 miles west and 12 miles east and consists of a single circuit of three No. 4 copper wires on poles cut from local timber. The bare copper wire was furnished by John A. Roeblings Sons Co. for a contract price of \$25,215.87. The amount furnished was sufficient for the construction of 38 miles of transmission lines and branches. The insulators, cross arms and pins were furnished and delivered for \$3,459 by Pierson, Rodeing Co. The total cost of the canal and temporary power plant was \$410,000.

CAMPS

Good care was taken to provide comfortable and satisfactory accommodations for the working force and the principal camp for the Lower Cherry power development was established near the power house at the Early Intake where several groups of comfortable buildings were erected in a very pleasant

many men remained working for the city rather than accept jobs at other places where the wages were higher, but the comforts were less.

Medical attendance and hospital accommodations are provided by the city which has organized and equipped a hospital staff and complete hospital supported by assessments of all of the aqueduct employees including those of the contractors and sub-contractors. This arrangement entitles any workman to receive free treatment except for chronic diseases acquired before employment and from disease or injury due to vicious reasons. The cost of the hospital building and equipment was \$17,505, that of camps and equipment, \$132,875.

The above described work was all designed and executed under the direction of M. M. O'Shaughnessy, city engineer of San Francisco.

Blasting Submerged Mud Cheaply

On the golf links of the Atlanta Athletic Club, there is a small lake. One end of it was covered with stagnant water. It was desired to create circulation of fresh water in this part of the pond and to throw the dirt removed from the bottom of the deepened portion into the center forming an island with a channel of flowing water running around it.

To accomplish desired results, it was decided to blast with dynamite, a semi-circular ditch. The cartridges were simply pushed down into the mud to a depth of 2 feet. The charges following the center line of the proposed channel were spaced 15 inches apart and a half pound of straight 50 per cent dynamite loaded in each hole. A blasting cap was attached to the charge in the center hole of the line. Concussion from the discharge of that charge set off all the other charges down the line on both sides. The shot created a ditch 8 feet wide and 4 feet deep and cost approximately ten cents per running foot.

State Highway Construction in New York

By Jas. H. Sturdevant *

The second of three articles. In this one are described principal features of clearing the site and building the foundation for all types of surface, and standard practice for concrete roads is reviewed, covering supplies, storage and distribution of materials, bins and unloading and elevating methods, concreting operations and concrete mixing.

In the new roads the full width of right of way from 50 to 100 ft. must be cleared, trees felled, cut into logs or firewood and removed, and branches and brush piled and burned.

Stumps and roots must be removed either with horse-power stump pullers or dynamite, and the ground prepared for grading.

Where the ground is covered with heavy timber, the cost of clearing may run from \$200 to \$1,000 per acre, and be more than offset by the value of the timber and firewood secured. Ordinarily, however, there is little salvage and the work is much lighter, requiring perhaps an average of 2 man-days work per acre. This work is done with gangs of about ten men. The clearing and grading may be done in winter weather with the use of dynamite, but the remainder of the work should be done when the temperature is not below freezing.

FOUNDATION.

The graders should finish the surface to within about 1 inch of subgrade which should be well drained and all soft spots should be replaced with stone or other suitable material to give a solid foundation.

The road surface may be of concrete, or of cement or asphalt macadam, brick, stone blocks, wood or various other kinds of pavement all of which except concrete require to be laid on a foundation course. For macadam roads the foundation course usually consists of stone forming a layer from 6 to 12 inches thick which should be thoroughly rolled with a 10-ton steam roller bringing it to a horizontal cross-section within $\frac{1}{2}$ inch of the required elevation. The stone may be distributed alongside the right of way by cars, automobiles or trucks and then shoveled and raked to position or it may be delivered directly on subgrade and dumped in piles, or even roughly distributed by a dumping-spreader device.

For macadam roads the foundation course is followed by a finishing course of smaller stones similarly applied, dressed to crown curve, thoroughly rolled and finally finished with the rolled binder course.

Brick, stone, and wood pavements should be laid on a solid foundation course, usually of concrete,

that is well set before the surface is carefully placed, finished and rolled according to specifications.

CONCRETE ROADS.

The most important feature in the construction of concrete road surface is to do first-class concreting rapidly and continuously which requires a careful study of local conditions and the installation of plant and equipment arranged so as to secure economy of handling and transportation, convenience of operations, and the elimination of delays of all sorts.

The subgrade and drainage should be completed at such a time and at such a rate of speed that the foundation will always be accurately surfaced, ready to receive the concrete a long distance in advance of the concrete mixer, and maintain its relative position beyond the possibility of the concreting operations approaching within 1,000 feet of the grading.

SUPPLIES.

Provisions must be made for the receipt, unloading, proper storage and distribution of cement, sand, and broken stone in sufficient quantities and rapidly enough and with enough reserve surplus to provide, first for local interruptions in the delivery to the mixing machine, and second, for possible interruptions in the general supply due to weather, transportation or other causes, thus necessitating usually the maintenance of a week's supply at the principal storage plants. One of the greatest opportunities for delay, inefficiency and extra cost is in the distribution which must be very carefully worked out to secure the minimum of handling and eliminate unnecessary hauling and delays or interferences.

Abundant water supply must be maintained at all times in the vicinity of the mixing machine, proper shelter provided for cement at the mixer, and arrangements must be made for the continuous operation and forward progress of the mixer.

STORAGE OF MATERIALS.

In the unusual event of aggregate and cement being purchased from large dealers at a nearby point, it may be possible to deliver them daily in limited quantities or by automobile trucks or even by teams and deposited in small quantities distributed along the roads.

Sometimes sand and gravel may be obtained by the contractor at one or more points along the right

*Division Engineer of first division, Highway Department, New York State, in charge of 12,250 miles of roads in 8,000 square miles of the Hudson River locality.

of way or nearby, or he may open a quarry or take stone provided by the grading excavation and crush it for concrete. In either of these cases, it is likely to be best to establish one or more storage plants at the points of production where it will probably be advantageous to maintain the cement storage unless it is more convenient and economical to deliver the cement directly to the mixers.

In many cases sand and gravel or broken stone are delivered on the railroad and on very rare occasions if the latter closely parallels the highway under construction, it may be possible to unload the cars close enough to the right of way to permit of approximate distribution when unloaded and allow the mixers to be supplied from the storage piles by wheelbarrows.

Ordinarily it will be necessary to establish storage at the sidings where the cars are unloaded. The most important point is to devise a system, best adapted to local conditions and topography, that will involve the least time, labor and cost both in unloading, in storing and in reloading for distribution along the line.

TUNNELS AND TRESTLES.

If the siding is on a side hill or trestle, the cars can be readily dumped directly into storage piles that may easily provide for gravity delivery to the distribution system. Where there is sufficient height and space it is probably cheaper to build a wooden framework on the surface of the ground covering a service track in turn covered by the aggregate which can be delivered through gates in the tunnel roof to fill the cars, buckets or batch boxes on the service track.

If it is necessary to use storage bins, they may often be advantageously built with siding and floors attached directly to the track trestle timbers or if on a slope, can be improvised simply with a vertical board wall or bulkhead at the bottom of the slope.

DERRICKS AND CONVEYORS.

If the cars must be unloaded on level ground, the materials will require artificial elevation to storage bins or to large storage piles and are often handled by ordinary boom derricks with clamshell buckets. Elevated bins may be provided with storage capacity for one or two days run of work and the materials loaded into them by the clamshell buckets until they are filled and the remainder deposited in storage piles adjacent to them on the surface of the ground and reclaimed if necessary as the bins are emptied.

The railroad cars may be dumped into a pit, hopper or boot between the rails allowing the materials to be automatically fed to the buckets of a power elevator that fills elevated bins or builds a storage pile on the surface of the ground. Here the bucket elevator system or the side hill system may often be installed at the contractors' quarries or rock crushing plant and the bucket elevators may be used at sand digging and washing plants. It is entirely possible to unload through a hopper to a belt conveyor and to transport stone, sand and cement by this conveyor or up a steep slope and discharge it at any point of a long series of bins, and conversely a belt conveyor may be used for delivering sand, gravel, broken stone and cement from storage for distribution.

Cars may be advantageously unloaded by hand with hoppers or chutes attached to the sides of the cars and delivering to service cars, automobiles or trucks adjacent to them on the surface of the ground. In all cases it is of course desirable to eliminate as much as possible hand work in unloading and storage operations.

DISTRIBUTION FROM STORAGE.

Storage plants should be located with regard to their proximity to the railroad or other source of supply, to the highway under construction, and so as to secure the shortest routes and the best grades for loaded vehicles. Usually, they should be placed at central position so that material may be delivered from them up to maximum distances of 2 or 3 miles in each direction.

For large work in level country the delivery on industrial tracks is likely to be the most economical and convenient. Care should be taken to arrange a simple plan for maintaining the tracks up to the mixers and for supplying a constant succession of loaded cars and returning the empty ones over switches and sidings and with cross-overs to eliminate any interference or possibility of interruption. Whether these tracks are laid on the right of way, or on the subgrade and how the return tracks are arranged will depend on circumstances.

The tracks are usually of narrow gage sectional construction and, although dump cars may be used for macadam road construction, they are seldom desirable for concrete roads and flat cars carrying one-yard buckets or batch measuring boxes can be hauled in trains drawn by gasoline locomotives. Batch boxes can be built by the contractor and conveniently filled up to the successive marks with sand, stone and cement, thus providing the required charge for the mixer that can be delivered to its receiving hopper with great rapidity and reduce to a minimum the delay between batches.

The use of batch boxes or buckets on the service train necessitates some kind of an unloading derrick at the mixer which may be provided either by a light boom operated by the mixer engine or by a locomotive crane or any other traveling derrick installed at the mixer. When the mixer is supplied directly by automobile trucks, the latter may carry batch boxes or buckets or they may have special bodies designed to act as measuring boxes for one or two or more batches, according to size of automobile trucks and of mixer. They may even dump on the ground close to the mixer and have the material shoveled into the hopper by hand at the cost of considerable expense and delay.

When sand and broken stone or gravel are distributed in continuous or separate storage piles along the right of way or on subgrade they should be placed on plank platforms or their equivalent that prevent any loss of materials or mixing them with dirt when shoveled into wheelbarrows.

CEMENT STORAGE.

When cement in bags is stored along the right of way great care must be taken to keep it elevated above the surface of the ground to provide against deterioration by moisture and to keep it properly covered and protect it from rain.

Sometimes the cement is stored on top of the

stone piles, which insures good drainage. In other cases it has been satisfactorily stored on small movable wooden platforms, 9 to 12 feet square, and covered with tarpauline or with wall tents provided with permanent frameworks that could easily be lifted off from the platforms exposing the piles of cement bags and making them perfectly accessible in pleasant weather, but permitting them to be instantly covered at the approach of a shower.

CONCRETE MIXERS.

All concrete should be machine mixed and the size and location of machines and the motive power should be carefully considered to conform to the requirements and conditions. Machines may be driven with steam, or gasoline engines, electricity, or even by compressed air, and they may be placed at intervals or continuously moved forward as the work advances, which is usually more desirable.

The mixers can be mounted on rolling platforms and drawn forward by any convenient method, but usually special machines designed for road paving are installed that move forward under their own power and deliver the concrete to a bucket automatically hauled out on a swinging horizontal boom that commands a section of the road from 15 to 30 feet long that is concreted from one position of the machine after which it advances an equal distance to the next position and so on. A gang of about 15 to 20 men will operate and move such a machine and finish the concrete if the aggregate and cement are delivered to the machine in such a manner as to avoid hand shoveling, wheeling or loading and unloading. Under favorable conditions a 3-bag mixing machine should average about 500 square yards of roadway 8 inches thick in one 8-hour shift.

CONCRETING OPERATIONS.

The spreading, screening, finishing and curing of the concrete must be made systematic and regular, all following at the same speed as the mixing and accomplished by special gangs, each of whom will be continuously busy without interference.

Special attention must be paid, if need be, to the construction of curbs and gutters, to the control of traffic on the new concrete and in the advance of construction work and to arrange, where necessary for by-passing traffic around working zone.

Prompt Action Necessary

"The aliens of this country, who cannot speak our language, who know not our laws nor our civilization, are being mobilized under the red flag of anarchy by the Bolsheviks for the purpose of overturning the American Government and bringing upon us the chaos that exists in Russia.

"No alien should be permitted to become identified with political or labor, or social uplift organization of any kind. The alien—alien in thought, in language and in spirit to everything that is American—cannot vote. He must be naturalized before he has the privilege of citizenship. Nevertheless, this same alien by becoming a member of labor, or of other organizations, can have a very powerful effect in shaping the political work of the country.

"These aliens are mobilized by anarchists in radical labor unions for the express purpose of affecting

politics, and through politics controlling the country. * * *

"The people of this country have reached a point where they must face once and forever, and settle once and forever, whether such elements shall rule this country to destruction, or whether Americanism shall prevail. The radical labor union of today is the mobilized power of alienism for the purpose of overthrowing the American Government."—*Manufacturers Record*.

Living Derricks

The use of ordinary masts for boom derricks was eliminated and the time, labor and expense of transferring them from place to place and erecting them was also reduced and considerable convenience and economy secured by the Aberthaw



FOOT BLOCK FOR STEEL DERRICK BOOM SUCCESSFULLY CLAMPED TO TREES SERVING AS DERRICK MASTS.

Construction Co., Boston, in the erection of a cotton mill for the Nashua Mfg. Co., Nashua, N. H. The work was executed in an oak grove, many of the trees of which had been left standing close to the site of the building so that it was possible to use their trunks for derrick masts.

A yoke of two short horizontal timbers connected at both ends by heavy screw rods was clamped to the tree trunks at any required height, and to one of the blocks there was attached a Chicago foot block for a steel derrick boom, the topping lift tackle of which was connected to the same tree or another one, thus enabling the boom to be operated as in a regular derrick.

This method of course necessitated the trimming away of some limbs to give clearance for the required horizontal swing of the boom, a matter which was not considered objectionable since many of the trees were eventually cut down and could just as well serve this temporary purpose. The boom was easily shifted from tree to tree.

PUBLIC WORKS.

Published Weekly at
243 West 39th Street, New York, N. Y.
by
Municipal Journal and Engineer, Inc.

Subscription Rates

United States and Possessions, Mexico and Cuba....\$3.00 per year
All other countries\$4.00 per year
Entered as second-class matter January 3, 1906, at the Post Office
at New York, N. Y., under the Act of Congress of March 3, 1879.

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western Office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, *Editor*
FRANK W. SKINNER, *Associate Editor*

Immediate Essentials of the Hudson River Tunnel

One of the most important public works at present under consideration in this country is the vehicular tunnel under the Hudson River between New York City and Hoboken, N. J. The cost variously estimated from \$15,000,000 to \$30,000,000 may, in this time of soaring prices, well enough exceed the upper limit and will depend on the size, type and location of the tunnel which are selective, and on the price of labor and materials which are highly uncertain. A great deal of discussion, some of it rather sharp, has arisen over the dimensions and details of the design, the location of the tunnel and the future amount of tunnel traffic.

It is pretty generally conceded that the tunnel is urgently needed; that the traffic will be great and increasing and will probably soon exceed any ordinary tunnel capacity, and that this tunnel will soon have to be supplemented by other tunnels, preferably located at some distance from it to serve different parts of the city and avoid undue congestion.

It is therefore evident that the subject is neither a single nor a determinate problem, and that it cannot possibly be fully solved at the present time on account of totally insufficient data and changing and uncertain conditions. Immediate and vigorous action is needed and is provided for by interstate legislation; the creation of a tunnel commission with powers; and the provision of liberal funds for preliminary preparations that will be supplemented by ample finances for executing the work.

The thing to do is to build an efficient tunnel as quickly, safely and economically as possible and this may well be left to the able commission, its associates and the eminent engineers and experienced contractors whose services they can command to assist in the development of the detailed design and the execution of the work.

There is no question that despite the serious difficulties of the site, vehicular tunnels are entirely practicable under the Hudson River at New York City. It is feasible to adopt the type, details and location that give the best results according to present knowledge and the state of the art, and even should they not develop the utmost potentialities of the situation, they will undoubtedly give good

value for the expenditure and no serious disappointment need be anticipated in the results of the construction.

The knowledge and experience gained in such important work will doubtless point to improvements that can be much more conservatively and successfully applied to future tunnels than to the present one. Under the difficult conditions and uncertainties, radical deviation from standard practice is undesirable considering the large scale and immediate necessity of the construction. Having determined how large a traffic to provide for at this time and bearing in mind that above certain dimensions, the larger the diameter of the tunnel the more difficult and costly it is to build it, the question becomes one of "safety first" plus the most economical methods that will give a maximum efficiency and minimum delay.

Heavy Extra Preliminary Construction Expense Sometimes True Economy

The construction of the great water supply and hydro-electric development for San Francisco, which had been contemplated for about 20 years, was actually commenced about six years ago and is now so far advanced that the legislation, litigation, and most of the surveys and other preliminaries to actual construction, have been finished, work on the permanent structures has been commenced, and plans for the future thoroughly detailed so that the completion of the work in 1823, about 9 years after it was commenced, is confidently expected.

The construction work is on a large scale and in remote and mountainous regions involving great delay, difficulty and expense, features which have been fully appreciated in advance and which, together with the great magnitude and extreme importance of the work have not only justified but demanded unusually thorough preparation for it. The conditions are such that the actual construction of the great dam, impounding reservoir, 18 miles of aqueduct and the power development involve an estimated cost of about \$20,000,000, while the other expenses increase the total estimated cost of the project to \$45,000,000 inclusive of about 136 miles of aqueduct between the power house and the city which is of comparatively simple construction.

Up to the present time a little more than \$8,000,000 has been expended, of which less than \$1,000,000 has been directly applied to the primary construction while nearly \$3,000,000 has been wisely expended on auxiliary works, the principal ones being the \$2,000,000 service railroad 68 miles long and the dam, aqueduct, and hydro-electric plant to furnish power for the main building operations, that have cost \$815,000. This power plant, described on page 203, besides being practically indispensable to the execution of the work, is remarkably efficient in its application of natural resources and in the great economy over any other kind of power development that might have been installed. Like the service railroad, it has been wisely planned for permanent retention after the completion of the water supply so that the cost may be properly

charged up to permanent valuable property and is still further valuable from the fact that, also like the railroad, it has an important earning capacity enabling it to produce a considerable independent revenue that has already amounted to about \$68,000, or more than 8 per cent. of its cost, an amount which may be considerably augmented and which would provide both for interest and amortization charges. This result abundantly endorses the expenditure of less than 2 per cent. of the total cost of the water system in order to do the work much more advantageously than it could have been otherwise accomplished. It is by such far-sighted utilization of all the potential values and by-products of a great scheme that big undertakings are made most profitable and satisfactory.

A Fair Deal for Municipal Transit

The announcement in the public press that Corporation Counsel Burr of the city of New York has moved to seize the property of the Interborough Rapid Transit Co. for operation by the city, or under its direct control, emphasizes a serious situation that calls to Heaven for the elimination of politics, or graft, or profiteering, or all three, for the interests and prosperity of the world's metropolis, the comfort and safety of many millions of passengers, and justice to the owners, managers and thousands of innocent stockholders in the subway property.

Discussion is too much involved and the issues are too great and complicated for any off-hand determination, but it should be remembered that the subways are now intensely vital to the city's life, which they have abundantly developed, and that in spite of their many imperfections and faults they are far and away the greatest and best system of the kind in the world.

While it is no doubt physically possible to serve the convenience of the public and promote its comfort to a greater degree, it is by no means certain that reasonable efforts have not been made to accomplish this, or that it is financially possible to do so under existing conditions, or that if it were it could be rapidly attained in the present labor and equipment markets.

There is no precedent in the world for physical conditions so difficult for the construction of such work on so great a scale as in New York City, nor have they elsewhere been met so satisfactorily and probably so economically. The builders of the subways have conquered what would only a few years ago have been impossibilities; have constructed a wonderful system, and have operated it with astonishing safety and success.

Whatever the very serious and undisputed inconveniences to the public through crowding, the service has many merits and the passengers not only receive their full money's worth, but very much in excess, and it is unquestionably very unfair to compel the company to transport a passenger the maximum distance of perhaps twenty miles, for a single five-cent fare.

It is questionable whether a five-cent fare is a high enough minimum for the shortest distance

under present conditions and while the high cost of living, labor profiteering, soaring prices of all materials and equipment and increased taxes have enormously increased the necessary expenses of the company, their revenue has not been permitted to be adjusted to it.

There is no question that justice demands a readjustment of charges to permit the company to earn a sufficient surplus to pay profits and to provide for maintenance, improvements, betterment and extensions. The only real point in doubt is the amount of profit that is just and fair.

The determined and persistent efforts on the part of a certain faction conspicuously represented by the Mayor of the city to discredit and ruin the existing transportation facilities with the avowed desire to assume municipal control and the obvious result of creating an enormous amount of patronage and political influence cannot be sufficiently deprecated and opposed. No intelligent citizen can fail to see that such a course would add enormously to the already outrageous burden of taxation, greatly increase the cost of transportation, and undoubtedly diminish its efficiency and safety by the destruction, invariably following such action, of economy, efficiency, and the incentive to improvement.

Profit Sharing with Labor Impracticable

Those with a maudlin tendency to shout for profit-sharing regardless of whether net returns are profits at all or whether the laborers have manifested any degree of faithfulness or efficiency or have already been overpaid, should read the report of the special committee of the Federation of British Industries which states definitely that profit-sharing is not desired by the workers, who are interested chiefly in obtaining high and regular wages; that the remuneration of the workers ought not to depend on the success or failure of the commercial management; that it would lead to great inequalities between workers in the different establishments; and that except where capital is very large compared with the number of workmen, it would yield only a small addition to earnings.

Profit-sharing is only just and defensible when the profits are in some measure due to extra loyalty and efficiency on the part of the workmen and certainly not when they are derived in spite of the workmen's indifference or incompetence. There is no reason why the fruits of industry, economy and enterprise should be awarded to employees that, as a rule are abundantly well paid for their services, unless they have some additional claim based on extra services or on some participation in improvements that have increased the gains. Too often the employe tries to give a minimum equivalent for a certain maximum wage while the employer bears all of the business risks and anxiety and has to contend with gratuitous labor troubles. Even when able services are entitled to extra compensation the cases are very rare when the labor is qualified to take any part in administration or commercial responsibilities, least of all when it comes to arbitrary control of its own employment, discharge and remuneration, the goal of labor agitators.

New York-New Jersey Vehicular Tunnel

Interstate Commissions, Board of Consulting Engineers and Chief Engineer report in favor of a \$28,000,000 double-traffic line, twin-tube structure about 9,200 feet long. It should be constructed in about four years, with an estimated practical capacity of 13,270,000 vehicles annually, that, the engineer assumes, may be fully utilized within ten years after the tunnel is open. The type of tunnel, dimensions, location and method of construction have been discussed at public meetings held by the American Society of Civil Engineers. At another meeting held by the National Highway Traffic Association the dimensions and capacity of the approved design and the possible future traffic were vigorously discussed; the design and necessarily indeterminate estimate of future traffic were attacked by a layman, and in reply the official design and conditions were ably explained by eminent engineers.

The legislatures of New York and New Jersey have appropriated \$2,000,000 for preliminary expenses and have created commissions with power. The commissions have appointed as chief engineer Clifford M. Holland, formerly engineer of tunnels for the New York City subways; and as a board of consulting engineers, Col Wm. J. Wilgus, formerly chief engineer of the New York Central Railroad, Major John A. Bensel, former engineer of New York State, A. Byrne, engineer of plant and structures, City of New York, J. Vipond Davies, consulting engineer, and the late Col. Henry W. Hodge. The chief engineers and the board of consulting engineers have investigated local conditions and requirements, made surveys and subterranean explorations, recorded traffic conditions and considered eleven plans of proposed construction.

After many months of exhaustive study, they recommend to the commission a twin-tube tunnel from Canal Street, Manhattan, to 12th Street, Jersey City, with separate diverging exits and entrances at both ends to develop the potential capacity of the tunnel and eliminate unnecessary congestion.

The report of the chief engineer of the New York State Bridge & Tunnel Commissions on the Manhattan-Jersey City vehicular tunnel under the Hudson River has been submitted to the Governors and Legislatures, but has not yet been issued to the public in print, although an abstract of it has been published by the daily press.

Under the river each of the parallel tunnels will consist of a shield driven cast iron tube 29 feet in external diameter with a concrete lining and a two-line roadway 20 feet wide having a vertical clearance of 13½ feet and a footwalk on one side. The segmental areas above and below the roadway will be utilized respectively for exhaust and supply ventilation ducts.

The tunnel will be nearly level and 3,400 feet long between pier lines with maximum adverse grades of 3.13 and 2.83 per cent. on the wider, three-line approach tunnels about 1,800 feet long at each end. It is expected that the maximum average day-time speed of motor vehicles in the tunnel will not exceed 12 miles per hour and that the tunnel will have at this rate a capacity of 3,200 vehicles per hour in daytime and, judging from the develop-

ment of traffic on the New York bridges, it should carry about 5,600,000 vehicles the first year and about 8,800,000 vehicles the sixth year, reaching its full capacity about the tenth year. The estimated cost of the tunnel is 28,669,000, which it is believed will be fully paid by tolls during the first eleven years of operation. Construction should be commenced in the fall of 1920 and completed in 1924 with a force of approximately 2,000 men.

Considerable prominence has been given to the construction of this tunnel with a lining of precast concrete blocks, recommended by Gen. Geo. W. Goethals, a type that has been successfully used in the important Mt. Royal land tunnel at Montreal and elsewhere, but which was not considered by its engineers to be most desirable for the Hudson River tunnel. It was therefore determined at a joint meeting of the New York and New Jersey Tunnel Commissions to have each of them adopt a resolution directing the board of consulting engineers and the chief engineers, to devote no further time to consideration of the precast concrete lining.

TRAFFIC ASSOCIATION MEETING.

Under date of March 4th, Elmer Thompson, secretary National Highway Traffic Association, called a public meeting in New York City under the auspices of the association to discuss traffic problems in relation to the vehicular tunnel. The invitations called attention to the early proposition for a single tube tunnel carrying three lines of traffic in each direction, then estimated to cost approximately \$12,000,000, and to the commission's recommendation of two 2-line tubes at a present estimated cost of \$26,000,000, and emphasized the importance of the traffic considerations involved which merit thorough public discussion. Public officials and other prominent men were invited and the attendance of about 100 included eminent engineers and contractors experienced in public works, and tunnel specialists.

OFFICIAL COMMENTS.

Clifford M. Holland, who was present by special invitation, briefly discussed the selected plan, emphasizing the impossibility of determining in advance accurate conditions or requirements and the necessity for prompt and reliable tunnel service which cannot be at all considered as the equivalent

of bridge service but as emphatically supplementary to it and, in the present case, as preliminary. As such it is imperative to build the safest, most conservative, and most economical structure that can be quickly completed according to present knowledge and facilities; the experience and developments thus attained serving as most valuable aid for the design, location and construction of future tunnels which must ultimately be required, whatever the final solution of the problem.

Mr. Holland showed that the approaches to the tunnel correspond to the neck of a bottle where the greatest congestion occurs limiting the service of the tunnel itself and therefore necessitating proper treatment of the approaches. He stated the maximum capacity of the tunnel and described the present commercial and traffic conditions and the methods of traffic investigations that indicated a large and uncertain increase of traffic that he assumed might probably exceed the tunnel's capacity after about ten years' growth. A material change in the capacity or proportions of the tunnel will greatly increase its cost to secure results not at present needed, and modifications, such as the adoption of an elliptical cross-section, would greatly reduce the proportionate area available for ventilation ducts and might increase the operating expenses of the tunnel from \$300,000 to \$2,000,000 annually, besides which we have no data of a submarine tunnel with elliptical cross-section by the shield method that is suggested for this tunnel. The commission is a trustee of public funds, and must act on uncertainties and approved standards.

PROPOSED FOURTEEN-LINE TUNNEL.

T. K. Thompson asserted that it was impossible to build a stable tunnel in the Hudson River at New York by the shield method and presented a plan for a concrete tunnel with rectangular cross-section 177 feet wide and about 35 feet high outside, with six 25-foot passageways to accommodate two or three lines of vehicles moving in the same direction in each. The tunnel to be built in sections, 700 to 1,000 feet long, floated to the site and sunk in position on a pile foundation in a dredged trench. The whole to be built for \$20,000,000.

OFFICIAL PLANS ATTACKED.

In the general discussion which followed, one of the first speakers made a violent attack on the alleged inadequate capacity of the tunnel and on Mr. Holland's careful and systematic methods of estimating future traffic which were ridiculed without, however, offering any evidence in opposition to them other than that of his personal opinion and assertions. The speaker's idea being that an almost unlimited quantity of traffic not now carried would immediately overwhelm the tunnel simply because the latter had become available.

TRAFFIC POSSIBILITIES.

Other speakers referred to the tendency, when new surface routes have been opened, for traffic to automatically shift to them and to create an increase in the total volume of traffic rather than simply change its arrangement.

It was pointed out that provision must be made for three entirely distinct kinds of traffic, namely, horse-drawn vehicles, faster moving trucks and

other commercial vehicles, and the fastest moving automobiles, which must to some degree be separated, although it was also pointed out that horses are becoming an increasingly negligible factor and that the relief to the ferries would afford them much greater and more desirable service there, even if they did not enter the tunnel at all.

The difficulties of overload or unreliable motor vehicles on the grades, the possibility of breakdowns and blockades, and the limitations of clearances between the different lines of traffic were discussed. It was stated that the clearance could be materially increased by modifying the diameter of the tunnel, but that for three lines of traffic, a larger diameter of tube is certainly necessary and would greatly increase the cost.

It was pointed out that the traffic capacity of the approach streets is reduced by intersecting streets, and that while a density of 0.6 of a vehicle per foot of roadway per minute requires relief, it is exceeded on Park Avenue. A moving sidewalk type of platform was suggested to develop maximum tunnel capacity.

COST AND LOCATION.

It was suggested that since there must necessarily be future tunnels, the plans should consider their location on widely separated lines and that they be provided with multiple entrances. The three-line traffic tunnel was estimated to have from 50 to 100 per cent. more capacity than the two-line tunnel, and estimates of \$15,000,000 and upwards for the costs of different type and capacity tunnels were offered for tunnels with 22½ to 24-foot roadways.

J. F. O'Rourke, speaking as an engineer and contractor, stated his willingness to build a tunnel with either the cast iron lining or with the precast concrete block lining and asserted that a 28-foot diameter tube with a 23½-foot roadway could be built by the latter method for \$17,500,000, while the same tunnel built with cast iron lining would cost \$30,240,000.

THREE-LINE TUNNEL.

The minority report to the commission was called for and read. It recommended a three-line of traffic tunnel, for which it assumed a roadway 24½ feet wide would be adequate and would involve a cost of 14 per cent. more than a two-line tunnel. These conclusions were disputed by Col. W. J. Wilgus, who stated that the increased cost would be about 21 per cent., equivalent to \$6,000,000, and that the 24½-foot roadway would afford very inadequate clearance for three lines of traffic, a condition which would result in pocketing the traffic. The engineers have given very great attention to the tunnel lining and have selected one involving a known expense, but are still at liberty to adopt any known expense, but are still at liberty to adopt any and economy.

At a late hour, a resolution was offered to the effect that it was the sense of the meeting that a two-way 22-foot roadway tunnel would very soon become inadequate, and that steps should be taken for the investigation and consideration of a larger tunnel. After denials that this resolution was prepared in advance of the meeting and that it was in typewritten form, the resolution was carried against a considerable negative vote.

Cement Joints Economical in Cast Iron Gas Pipes

The conclusion drawn from records of two years' work in laying large quantities of cast-iron pipe 4 to 30 in. in diameter is that the cost of cement mortar in hub and spigot joints is only from 25 to 50 per cent of the cost when they are calked with lead.

In discussing this subject in a paper presented to the Pacific Coast Gas Association, W. M. Henderson said, in part:

"The practice which is more or less general of using neat cement for packing the joint is not proper, and will not give the satisfaction obtained from a mixture of portland cement and sand. Neat portland cement, in setting, rises in temperature over a range of 60° F. to 150° F., or not in excess to 10° F. in 12 hours. This is considerable expansion during setting of neat cement, which will likewise be followed by contraction. This fact accounts for the shrinkage cracks. Quick setting cement is preferable, but cements in the market give little choice in this respect. Good clean sand, not too fine, and not necessarily sharp, will make a strong mortar. The yarn is also an important factor; the old hemp rope, the standing rigging from sailing vessels, cannot be excelled.

The best mixture for the joint is three parts cement to one part sand, and just sufficient water to make a dough that will hold its shape. The quantity of cement, sand and water should be mixed as necessary for each joint as it is made.

In laying pipe for cement joints the procedure is very much as with lead, with a few additional precautions. The pipe must be in its permanent resting place well blocked and tamped. As much as possible of its surface should be covered with earth, so as to protect it from change of atmospheric temperatures. One should also avoid stepping on the pipe when getting in and out of the ditch; this should be a hard and fast rule, particularly after cement joints have been made up and are green. The joints are best made in the afternoon, permitted to set through the night and tested the first thing in the morning. If they are found to be tight, the backfilling should be done at once to protect the pipe from the heat of the day. Those joints left exposed during the day must be shielded from the sun's rays, and it is well to cover them with a wet sack as addition protection.

In making the joint the bell is first cleaned by the hand bellows. Then a strip of hemp yarns is placed in the bell and driven home; this should be made tight. The balance of the bell is then filled with the mixture of cement grout; this is usually placed in the joint with the fingers and rammed in by a yarning iron or a wooden tool of similar shape. The cement is packed until it properly fills the bell, then another strip of yarn, coated with mortar, is set in the bottom of the bell and forced into the ring. The balance of the space to the face of the

bell is filled with either neat cement or the same mixture and the entire joint is pointed at an angle of 45°."

Cost of Making Lead Joints.

Size of Pipe		Lead Per Joint	Yarn Per Joint	Time Per Joint	Total Cost
4"	Quantity	10-lbs.	.33-lbs.	12 Min.	
	Cost	.77	.042	.1375	.95
6"	Quantity	12-lbs.	.50-lbs.	12 Min.	
	Cost	.924	.063	.1375	1.12
8"	Quantity	18-lbs.	.55-lbs.	15 Min.	
	Cost	1.386	.07	.1718	1.63
10"	Quantity	20-lbs.	.80-lbs.	20 Min.	
	Cost	1.54	.102	.2291	1.87
12"	Quantity	24-lbs.	.80-lbs.	24 Min.	
	Cost	1.848	.102	.275	2.23
16"	Quantity	32-lbs.	1.20-lbs.	30 Min.	
	Cost	2.464	.152	.6875	3.30
20"	Quantity	42-lbs.	1.66-lbs.	30 Min.	
	Cost	3.234	.21	.6875	4.13
24"	Quantity	50-lbs.	2.00-lbs.	40 Min.	
	Cost	3.85	.254	.9166	5.02
30"	Quantity	70-lbs.	2.75-lbs.	60 Min.	
	Cost	5.39	.349	1.375	7.11

Cost of Making Cement Joints.

Cement Per Joint	Yarn Per Joint	Sand Per Joint	Time Per Joint	Total Cost
3-lbs.	.25-lbs.	2.00-lbs.	15 Min.	
.018	.032	.025	.1718	.25
5-lbs.	.33-lbs.	3.33-lbs.	15 Min.	
.045	.042	.042	.1718	.30
6-lbs.	.50-lbs.	4.00-lbs.	20 Min.	
.054	.063	.05	.2291	.40
8-lbs.	.66-lbs.	5.33-lbs.	24 Min.	
.072	.084	.068	.275	.50
10-lbs.	.75-lbs.	6.66-lbs.	30 Min.	
.09	.095	.083	.3437	.61
12-lbs.	1.00-lbs.	8.00-lbs.	30 Min.	
.108	.127	.10	.6875	1.02
15-lbs.	1.25-lbs.	10.00-lbs.	40 Min.	
.135	.159	.125	.9166	1.34
23-lbs.	1.75-lbs.	15.33-lbs.	60 Min.	
.207	.222	.192	1.375	2.00
30-lbs.	2.00-lbs.	20.00-lbs.	1 hr. 20 Min.	
.27	.254	.25	1.8332	2.61

Excavating a Mountain of Rock

Millions of yards of hard rock and ore excavated by twenty-one steam shovels digging eighteen successive terraces.

The Copper Queen Mine of the Phelps-Dodge Corporation at Bisbee, Arizona, consists of about 10,000,000 yards of very hard rock and ore forming Sacramento Hill which is an igneous mass of monzonite-copphy located between the ports of Bingham Canyons.

The rock and ore are being removed from the surface for a height of 1,600 feet by steam shovels operating in 18 successive terraces from 40 to 250 feet wide, average 100 feet, and with height of 60 to 120 feet. At the bottom of the mountain the average vertical distance between terraces is about 70 feet. During 1918, notwithstanding the war conditions and difficulties of industrial operations, more than 4,270,000 yards of rock and nearly 6,000,000 yards of ore were excavated and the operations had been systematized and are progressing with increasing rapidity.

BLASTING IN TERRACES.

Operations were commenced by blasting off about 150 feet of the sharp top of the mountain. Holes were drilled with churn and air drills, charged with about 11 tons of powder and simultaneously fired, making a fairly uniform surface on which grading and track laying were immediately commenced. The top of the mountain was reached by about

In the lower benches the 3½-inch holes about 30 feet deep are drilled by an F-24 Ingersoll machine and are protected by a box at the top of the hole. The holes have a tendency to ravel and some that have been drilled by cyclone drills were cased with iron pipes to prevent them from filling up.

LOADING AND FIRING.

The holes are loaded with red H. No. 4 dynamite marked 60 per cent. and manufactured at Bachus by the Hercules Powder Co. In June, 1919, 369,000 pounds of explosives were used to shatter 1,035,000 yards of rock.

The holes are sprung with a preliminary charge of explosive and, before it is fired the workmen are warned by a long whistle and three short ones and take refuge in huts made of old railroad ties. A completion of the blast is signaled by two long whistles after which the men return to their work. Large fragments of rock are block holed when necessary and the loose material is barred off and forms slopes of about 75 degrees that are removed by the steam shovels of which there are now in use 17 Marions, two Bucyrus and two Atlantic.

HANDLING ROCK AND ORE WITH STEAM SHOVEL.

The shovels are installed on tracks about 25



TWENTY-ONE STEAM SHOVELS, WORKING IN EIGHTEEN LIFTS, REMOVING A MOUNTAIN 1,600 FEET HIGH, CONTAINING 10,000,000 YARDS OF HARD ROCK AND ORE.

2¾ miles of railroad track, most of it at a grade of 2½ per cent. with sharp curves and two switchbacks.

Three hundred feet of the upper part of the hill is being removed in four terraces with 3 sections 60 feet high and one with a maximum height of 120 feet. The excavation of the upper bench was commenced first and was kept well in advance of the lower benches in order to avoid possibility of undermining.

feet from the service tracks on which five-car trains receive the ore that is hauled by locomotives. All of the shovels are covered by a housing of ¾-inch planks, sheathed with steel to protect the crew of engineer, fireman, crane man and coal man from flying stones. Each shovel also requires a crew of five to lay the five foot lengths of track ahead of the shovels, operate the jack screws and keep the loading track clear of broken ore.

Owing to the fact that coal can be secured within

a distance of 130 miles from the mine, the shovels are still operated by steam, although it is anticipated that electric shovels will eventually supersede steam shovels.

Each shovel makes a cut from 20 to 25 feet wide and each terrace is equipped with one line of compressed air and another line of water pipes.

The steam shovels deliver into 30-yard 5-ton automatic Clark cars, 12-yard Oliver cars and on the top level into 4-yard and 6-yard crab cars.

STORAGE.

Parts of the material are sent directly to the mills and the remainder containing a smaller percentage of copper is stored until it can be treated at the leaching plant. Considerable difficulty has been encountered in providing storage places and a number of service tracks are run up different to provide spoil banks in three of which, 20,000,000 tons have already been deposited. Ore is taken to the mill, which has a capacity of 4,000 tons per day, in 20-yard side dump cars that discharge their contents to a grizzly over a 56 x 84-inch rock crusher. When operations were in full swing last year, from 20 to 25 trains per hour were delivered from the four upper benches.

The work is under the direction of A. G. Goodrich, chief engineer, and Arthur Notman, general superintendent.

Pompton Lakes Municipal Hydro Electric Plant

A population of three thousand is a rather inconspicuous figure in this country of large cities, yet when it comes to initiative, the town of Pompton Lakes, N. J., demands recognition. Proof of this claim may be found in the development of its municipal hydro electric plant.

The former municipal power station was typical of a large number of plants established throughout the United States. Motive power for the two 50 kw. generators was provided by 75 hp. gas engines, and a daily consumption of from two to three tons of coal was essential. In addition to this, the staff expense was comparatively high as it was necessary to employ a superintendent and four assistants.

With an increasing use of power, the authorities found that the old station would not be large enough to supply the demand and it was decided to build a new power plant on a more generous scale and also on a more economical basis, utilizing as motive power the overflow from Pompton Lakes. These lakes, which are fed by the Ramapo River, are comparatively close to the town.

A subscription was raised, and the dam was purchased from the Corning estate by the municipality. New headgates were installed and a flume, 100 ft. x 24 ft. x 10 ft., was built from the dam to the power station, the overflow operating two S. Morgan Smith vertical water turbines of approximately 125 hp. and 225 hp. capacity at a 21 ft. head. Woodward oil pressure governors 6 inches x 12 inches and 5 inches x 9 inches are used.

The turbines are direct connected to vertical generators of 100-kv-a, 300 rpm. and 250-kv-a, 200 rpm. capacity respectively, the combined weight of the water wheel and generator rotors being carried by a Kingsbury thrust bearing supported by the

upper guide bearing bracket of the generator. As the peak load at present is only 85 kw., the smaller unit develops sufficient power to meet this demand, but both units are operated alternately. The exciters are belt driven by one quarter-turn belt and idler. The generators operate at 2,400-volts, 3-phase, 60-cycle with 125-volts excitation.

A balanced regulator furnishes current for street lighting at 2,400-volts.

The generators, exciters, street lighting transformer and the 5 panel switchboard controlling the entire equipment were built by the Westinghouse Electric & Manufacturing Co.

The building is a 30 ft. x 60 ft., two-story, brick structure, concrete floored, and with a general office, transformer room, generator room and a garage, affords more than ample space.

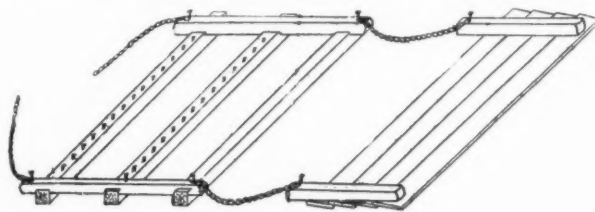
In addition to house lighting for the town, this plant furnishes current for approximately thirty miles of street and road lighting, operates the pumps that supply the local reservoir and is used by five factories, and an electrified coal elevator. In the near future, electric power from this station will also be used by the towns of Riverdale, Pompton Plains, Haskil and Midvale.

The efficiency of this power plant is unusually good and it is stated that the net operating cost is only about one-third of that of the old station. Certainly with the prevailing situation, Pompton Lakes is in an enviable power supply position.

Mr. J. A. Burrell, chief engineer, and two assistants constitute the staff, as compared to the staff of five required to operate the old station.

Home Made Roadway Planer

A roadway planer designed and successfully used by E. H. Winslow, chief engineer of the South Carolina State Highway Commission, is a combination of spiketooth harrow, drag and smoother that can be drawn by six mules or, preferably, by a tractor. It can be built by any carpenter or black-



ROADWAY PLANER FRAMED OF SQUARE TIMBERS.

smith and has been constructed for as little as \$15. The 1¼-inch square spikes should be 8 inches long and case-hardened and the frame may be made of timber or even of old railroad ties. It is not intended to take the place of a plow and its dimensions are such as to span short depressions and cut off only the high points of the road surface, thus equalizing humps and hollows.

The Pennsylvania State Highway Department Engineering School has for the March term, an attendance of 350 construction inspectors, county road superintendents, assistant engineers and district engineers, and is the first school of its kind instituted by an American commonwealth.

Moving Harrison Street Viaduct.

The construction of the new Union Station Terminal, Chicago, required the rebuilding of the Harrison St. viaduct more than 500 feet long which is being reconstructed in two longitudinal halves. The old structure consisted of three 146-foot trussed spans and one 78-foot plate girder span all of which were moved transversely 18 feet and raised 2 feet vertically to carry traffic while the first half of the new viaduct was built on the site formerly occupied by the old viaduct.

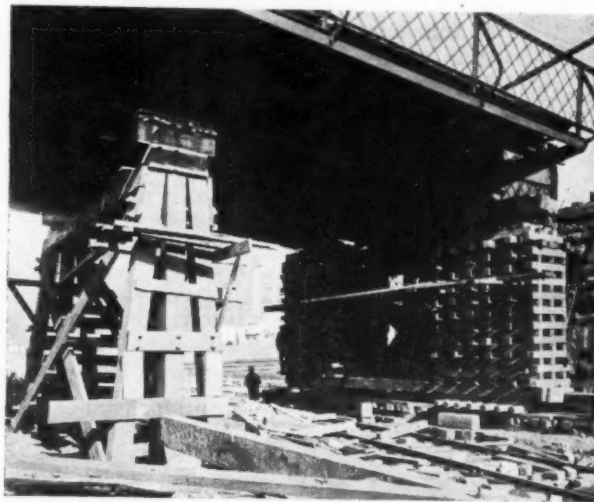
The piers and abutments of the old structure were extended, in the direction of the movement, by crib work and by framed tower bents, both carrying skid rails to support the trussed spans during transit. The spans were connected by longitudinal 24-inch I-beams and the trussed members were reinforced by temporary wooden struts.

Four-post wooden jacking towers were erected under the ends of the trusses and jackscrews placed under them were operated to lift the spans 2 feet, enabling timber sills parallel to the abutments to be placed under the ends of the spans and seated on solid cast steel bearings on the skid rails. The jackscrews were then slacked off, permitting the spans to be supported on the skids and in 12 hours the bridge was moved transversely to the new position by securely braced horizontal jackscrews.

The plate girder spans were handled in a somewhat different manner. Transverse timber roller tracks were built on the surface of the ground under each end of the span, long hard wood rollers about 3 inches in diameter were placed on them in two groups, and above them were set long track timbers, each set supporting a pair of timber cribs, one under each side of the spans. These cribs were built up nearly to the under side of the girders, jackscrews were set on them and supported pairs of transverse timbers that were adjusted to bearing against the bottom flanges of the main girders.

When all was in readiness, the jackscrews on the cribs were operated to take the weight of the span from the abutments and transfer it to the

cribbing and the spans and cribs were moved transversely on the roller tracks, the live rollers being taken out in the rear and replaced in front as they were released by the advance of the span. After reaching its new position a falsework timber tower



FALSEWORK TOWER AND END CRIBBING UNDER PLATE GIRDER SPAN.

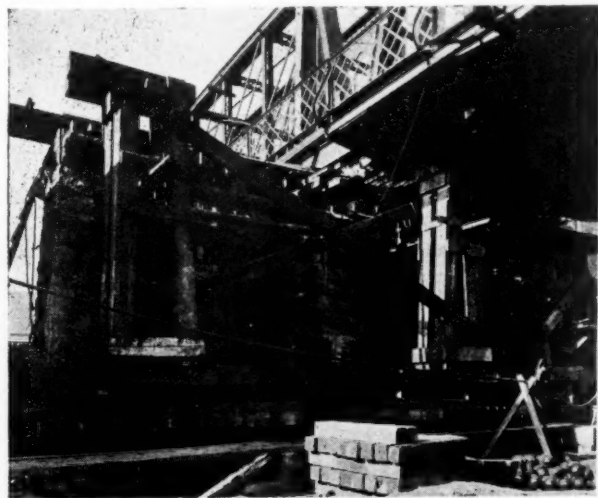
was wedged up under the span near the end as shown in the illustration.

After the construction of the first half of the new viaduct, the old viaduct will be dismantled and removed and the second half of the new viaduct will be built in its place.

While the old viaduct was being moved, work was commenced on the construction of the superstructure of the new viaduct. The foundations were built in caissons $4\frac{1}{2}$ feet wide and 48 feet long which carry the new viaduct columns. The old viaduct was moved by the L. P. Friestedt Co., Chicago.

Illuminating Gas Oil Supply Seriously Threatened

Large quantities of oil are used by the gas companies of New York City in the manufacture of the type of illuminating gas generally used in the metropolis. This is known as water gas, is prepared by passing steam through anthracite coal heated to incandescence, and then enriched by the addition of oil and certain carbons to increase the lighting value. The New York and Richmond Gas Company, supplying Staten Island with illuminating gas, is entirely equipped for the manufacture of water gas and could not change its plant to manufacture coal gas for a period of several months. The company's contract for gas oil will expire on March 31, and the company is decidedly uncertain as to its ability to secure supplies of such oil after that date. Oil companies to which the gas company has had recourse have stated their inability to furnish the necessary oil. Other companies may be in the same situation shortly and the Public Service Commission for the First District, New York, has therefore called a hearing, in order that the facts may be determined as a basis for possible future action.



JACKING TOWERS FOR LIFTING TRUSS SPAN.

An Unsuccessful Water-works Plant

A municipal plant in a city of five thousand population has been outgrown, no considerable increase in capacity or efficiency having been made in twenty-five years. It may break down any day, with disastrous consequences.

It is not often that a public official admits that a municipal plant is not a success; but much can be learned from failures as well as from successes, and because of the lessons that it seems to convey, we are giving a description of a plant which is not a success. The name of the city is not important; it is only necessary to say that it has about 5,000 population and it is in the state of Illinois.

Water is obtained from two 6-inch wells 125 feet deep, from which it is pumped into a water tower 110 feet high. There is only one pump, a single-acting, triplex, plunger pump. For operating it there have been installed a fifteen-horse-power electric motor and a twenty-five-horsepower gas engine. Concerning the entire plant, the superintendent (a local plumber) writes: "The only thing up to date is the meters—every service is metered."

The capacity of the wells was practically reached two years ago, when the water level was so reduced that the pump pit and pump were lowered twelve feet. (The question occurs whether it would not have been better, and cheaper in the long run, to have put in one or two additional wells.) The pump pit was made large enough to install another pump, but this has not been done. To supply the consumption, the pump has to run an average of about 20 hours out of the 24, and if it should ever break in such a way that it could not be repaired within a few hours, the city would be entirely without water.

The power first used was a motor with an automatic starter and stop, for starting the pump when water was low in the tower, stopping it when the tower was full. So long as this operated, the only attention required was to oil the pump once in a while. This plan operated well for two years, but one night something failed to work and the motor was damaged to an extent requiring \$700 for repairs. The city then bought a gasoline engine as a stand-by but continued to operate the motor, but this again was burned out six months later and repairing it cost \$1,000. The city then decided that it would be necessary to keep a man at the plant all the time. Concerning the gas engine, our informant states that there has been considerable trouble with this also, but does not designate just what this has been, simply stating that it is out of order about half the time. Either one costs about \$1,000 a year to operate. He believes that steam would be both more reliable and cheaper than either gasoline or electricity, so long as it is necessary to keep some one at the pumping station continuously.

As to the relative costs for interest and depreciation on the electric and gasoline units, this cannot be given, because no record has been kept of the cost of any parts of the plant.

The steel water tower, when erected twenty-five years ago, was guaranteed for twenty years, and the superintendent says that it should be condemned.

Summing up, he states that the plant has been outgrown and is too small, the wells have not sufficient capacity and more water is needed, the pressure is very poor, the pumping station is too small and is out of date, the pumping plant is liable to break down at any time and entirely stop the service for an indefinite period. There are 800 water takers, the largest being the creamery which uses about 6 million gallons a year. The rate is 25 cents per thousand gallons up to 100,000.

This plant certainly seems to need a complete overhauling and reconstruction after its 25 years of service. It would appear as though there had been a general failure to appreciate the importance of keeping its various elements up to effective capacity and serviceability. It may, of course, be that at no time when improvements were needed did the company feel financially able to make them, but it would seem as though the time is not far distant when it will either have to abandon this plant or incur, all at one time, a very considerable expense which will be felt more seriously than the same or a less total distributed over a number of years.

A Mountain Climbing Motor Truck

Ten years ago it took 28 mules three days to transport a nine-ton boiler 5,000 feet up in the Sierras to the Madera Sugar Pine Mills, 60 miles distant from Madera, Cal., the nearest railroad point. Recently a five-ton Federal motor truck performed the same task in one day, despite the prophecies it would never make the steep mountain grades and pitches.

The roads were considered treacherous, full of dangerous winding turns, often attaining a grade of 20 per cent. Experienced truckmen who saw the boiler loaded from a flat car to the truck prophesied that the trip could not be made, but it actually arrived at the mills, 65 miles up in the mountains without a mishap.

There are many of these donkey engines at the mills in addition to locomotives which are used for hauling timber from the forest to the mills. All of this machinery must be hauled over the mountain roads. The value and economy of the new method, which replaced mule transportation, is strikingly illustrated in the incident related above.

In order to save the brakes of the truck which carried this nine ton boiler, it was necessary to chop down one of the larger trees and drag it behind the truck whenever a steep grade was reached.

In one place the flume, which permits the lumber, cut up, to float down to Madera, had to be cut to allow the truck to pass with its huge load.

This unusual and tortuous trip was successfully accomplished by Clarence Row, one of the expert mountain drivers of this motor truck line, whose experience on this particular mountain road was to a great degree responsible for the success of the trip.

Importance and Economy of Salvaging Road Asphalt

Details of Cost of Reworking and Relaying Worn Asphalt Pavement Surfacing in Washington, D. C.

54 Willow Avenue,
West Somerville, Mass., March 4, 1920.

Sir:

I was quite interested in the three paragraphs on page 106 of the February 14th edition of "Public Works," the subject of which was "Use of Removed Material," and it struck me that the salvaging and reworking of old materials taken from worn places and surface cuts in bituminous pavements was somewhat lightly treated in the article, as I have in mind at least one case where the practice of reheating, remixing and rehabilitating this old material has been carried on since 1912 with excellent success and an enormous saving of mineral aggregate as well as an appreciable saving of the bituminous content of the old pavement.

The city referred to is Washington, D. C., in which there was laid a daily average of approximately 460 square yards per day of 2-inch thick pavements consisting of reworked old material, for the year ending June 30, 1918, and previous records indicate that this is a fair example of what had been done during the several years preceding 1918.

My recollection of the formula under which this pavement was made is as follows:

Old material, 66 per cent; fine sand, 23 per cent.; trap rock screenings, 6 per cent.; limestone dust, 2 per cent.; bituminous cement, 3 per cent. This may not be the exact formula but is a very close approximate.

Extraction tests made on the result of mixture show a bituminous content soluble in carbon bisulphide of 9.8 per cent. This would indicate that, irrespective of the saving of the old mineral aggregate, there was accomplished a very considerable saving in bitumen.

This practice, of course, results, not only in the actual saving of the material, but in a very appreciable saving in labor cost as well, which would otherwise be involved in the carting of this old material to a dump.

I have an idea that one of the reasons that this practice is not generally followed is because of the lack of the proper kind of equipment for economically reheating and reworking the old pavement.

The plant employed by the District of Columbia has a capacity of 1,000 square yards per day of new pavement, and which will turn out from 500 to 600 square yards per day of old pavement. This plant is of such a design that it can be employed with equal success in the reworking of old pavement or in the manufacture of new pavement and can be alternately used for either service without

any change whatsoever in the plant. A great many cities have municipal asphalt paving plants, of a different design, which can only be utilized in the manufacture of new paving material.

It might be interesting to you also to know that the city of Milwaukee, Wis., also follows out practically the same scheme of reworking old pavement as that followed by the city of Washington, employing the same type of plant. I believe that investigation of this particular condition would develop some very interesting data.

The information that I have given you is, of course, only a close approximate and has not been verified as regards its application to existing conditions, but if you care to use this information for publication you are welcome to do so.

Your very truly,

H. L. ALLEY.

P. S.

Mr. Alley supplemented this interesting statement with some data, published about a year ago on asphalt costs in the District of Columbia, which stated that at the municipal plant they had been, the previous year an output of 151,152 cubic feet of old asphalt re-worked mixture at an average material cost of \$0.0844 and a total cost of \$0.4529 per cubic foot in place.

Reserve Pumping Unit Saves Kalispell \$15,000 Annually

The water supply for the city of Kalispell, Montana, is handled by an electric pumping station with a capacity of 8,750,000 gallons daily. Recently the mayor of the city secured a reclassification of insurance policies in consideration of the installation by the city of an auxiliary reserve pumping unit equal to one of the electric units already in service.

A steam turbine, operated from a 250 h. p. water tube boiler, was coupled to the extended shaft of one of the electric pumps and thus provided for any interruption of the electric service furnished from a hydro-electric plant which has heretofore never been subject to interruption.

The provision of this reserve satisfied the insurance company and secured the reclassification which has reduced the rate about 33 per cent., thereby effecting an economy to the property holders in the city of about \$15,000 per year in premiums.

Waterworks superintendent, W. H. Lawrence, writes that he has never yet had occasion to use the steam plant for pumping water, but that it meets requirements and is ready for service if needed.

Contractors' Percentage Fees and Estimating Charges

The contractors' committee of the local building exchange, Duluth, have made the following recommendations to govern contract and sub-contract work:

Percentages adopted on all percentage work \$1,000 to \$5,000, 15 per cent.; \$5,000 to \$25,000, 12½ per cent.; \$25,000 to \$50,000, 10 per cent.; \$50,000 to \$100,000, 9 per cent.; \$100,000 to \$200,000, 8 per cent.; \$200,000 to \$500,000, 7 per cent.; \$500,000 and up, 6 per cent. This is to include all small equipment; engines are to be charged for at the rate of \$2.50 per day; steam concrete mixers the same; small gasoline mixers \$1.50 per day; derricks and special equipment at special rates.

A charge of 1/10 of 1 per cent. is to be made for furnishing preliminary estimates on buildings for owners and architects; this charge to be refunded when the estimator secures the work.

Each proposal is to include this clause: "This proposal is subject to acceptance within ten days from date."

We object to furnishing certified checks when bidding for private parties.

We object to paying for plans whether for ourselves or for sub-contractors.

We recommend that the uniform contract as adopted by the American Institute of Architects be adopted by the local architects.

We object to paying for the privilege of figuring plans, unless the check given is returned when plans are returned in good condition.

We recommend that no unit prices be furnished except by the successful bidder when the contract is signed, and when such units are furnished there are to be two unit prices; one for additions and one for deductions. These unit prices are to be based on the governing prices of labor and material at the time of submission of bids.

We recommend that the lowest bidder be paid for figuring plans and submitting a bid when no contracts are let—this payment to be based on 1/5 of 1 per cent. of amount of the bid.

We recommend that responsible bidders only be invited to figure and that no one be asked to figure unless the architect himself and the owner are willing to let the contract to such bidder.

We recommend that the specifications provide that each sub-contractor shall pay his proportion for cutting and patching.

We recommend that the different items entering into the specifications be subdivided by paragraphs and that all items be specified in their respective paragraphs; each one of which should be governed by the general conditions of the specifications.

We recommend that the architect specify clearly whether the owner or the contractor, is to furnish

temporary heating for the building. We recommend that the specifications be more specific as to the number, amount, and locations of different articles; for instance, no such clause as this should exist: "Furnish material where required by architect." We recommend when bids are advertised to be in at a certain time that no bids be considered when received after such time.

We recommend that the contract provide for an adjustment in case the wage scale is changed during the life of the contract.

Dynamiting Earth Cuts for Highways

It often pays to blast down high banks along highways with dynamite in preference to employing old style pick and shovel methods or rooters drawn by teams. In many cases, stumps are encountered on top of the banks and gravel or small boulders are interspersed through them. These make it difficult and often impossible for the teams to pull the rooters and the breaking of machinery or harness or the injury of the horses may result.

Frequently by putting down vertical holes in the top of the banks, 3 to 5 feet back from the face and loading them with a few cartridges of dynamite, much time and labor are saved. The banks are thrown down into the roadway in loosened condition ready to be loaded on wagons or removed by scrapers and used for fills.

There are cases where dynamite has thrown down as much dirt as a result of twenty minutes' work putting down and loading holes as teams and rooters could remove in a day.

Menton Sand and Gravel Plant

Aggregate for about 6 miles of road near Menton, Ind., has been very satisfactorily produced by E. A. Gas, Warsaw, Ind., contractor, who installed a portable plant for washing and storing sand and gravel that reduced its cost to about one-third of that of aggregate purchased in the market and shipped to the site.

The plant was installed on a large gravel bed containing a high proportion of sand. A bucket elevator, with the boot covered by a horizontal grating was erected and delivers into a circular screen that grades the pebbles from ¼-inch to 2-inches and discharges them into elevated storage bins from which they are loaded by gravity, as required for transportation to the concrete mixer. The pebbles are washed by water pumped from a near by well through a 4-inch pipe and the sand, graded to ¼-inch, is received in settling tanks from which the surplus overflows to make an adjacent fill.

Sand and gravel are delivered to the grating over the elevator boot by three teams operating scrapers and producing an average of about 60 yards of aggregate daily. As fast as the haul becomes excessively long for the scrapers, the plant is readily shifted and is thus kept in continuous operation with a maximum capacity of 75 yards per day. The elevator and screen are driven by a 6-hp., gasoline engine and the pump is operated by a 12-h.p. 4-cylinder automobile engine. Two 4-yard trucks keep the concrete mixer supplied when the haul is short.

Newark Sewer Tunnel

Heading About 7 Feet Diameter Driven Under Pneumatic Pressure with Permanent Steel Roof Plates; Shaft Lined with Tongue and Groove Sheeting; Concreted Top and Bottom; Air Lock Set in It, and Concrete for Tunnel Lining Delivered by Pneumatic Process.

Section 30, Newark branch intercepting sewer, has 3,310 linear feet of circular tunnel with reinforced concrete lining 12 inches thick and 57 inches inside diameter.

It is located on street lines with the invert about 27 feet below the surface on a grade of about 1 to 1,000. For a length of about 1,400 feet it is located about 4 feet below and generally a short distance to one side of an existing 3 feet 6 inch x 4 feet 10-inch brick sewer in service with which it will be eventually connected by a gate chamber at one extremity of the line. Above the sewer, there are installed under the roadway 6-inch water mains, water service pipes, 2-inch gas mains and 8-inch local sewers and branches all of which are maintained in operation without disturbance.

The soil encountered is chiefly sand, loam and clay with ground water level at or near subgrade which is sometimes a foot or two above or a foot or two below it. The construction of the sewer involves about 3,000 yards of concrete, and 27,000 pounds of reinforced steel, exclusive of the shaft and gate chamber. The contract calls for the completion of the work in a limited time after the award was made May 10, 1919, and the contractor being allowed to build the sewer by open trench or tunnel methods, elected to use the latter.

The methods have been carefully planned, first class equipment installed, and scheduled progress is being made by the contractor, The North Atlantic Construction Co., that is executing the work under the direction of W. M. Brown, chief engineer of the Passaic Valley Sewerage Commission.

SHAFT EXCAVATION AND BRACING.

The tunnel is now being driven in both directions from a 16 x 18-foot temporary shaft located near the central point of the line. The upper part of the shaft was excavated in the open, in dry soil by pick and shovel, the soil being loaded into a 1-yard steel bucket and hoisted by a stiffleg derrick installed on the surface.

As the excavation progressed, the sides were

sheeted with 3-inch tongue and groove wooden planks 16 feet long driven by a light steam hammer suspended from the derrick boom. The piles were driven successively 1 or 2 feet at a time to keep their lower ends 1 or 2 feet below the bottom of the pit as the excavation progressed.

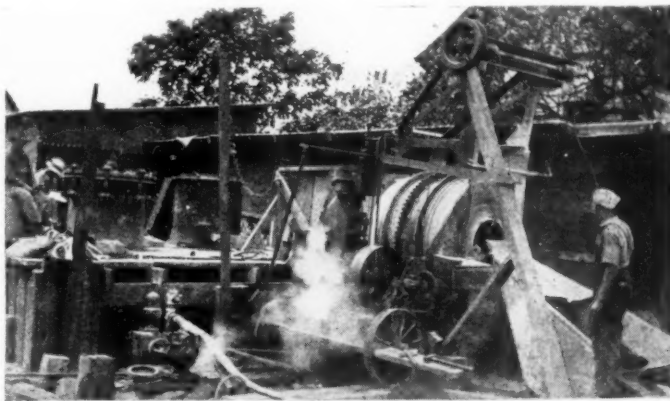
The shaft was braced with 8 x 8-inch timbers and at a depth of about 16 feet below the surface excavation was suspended while interior forms about 7 feet high were built enclosing a 10 x 12-foot rectangle parallel and concentric with the exterior walls.

The space outside the forms was concreted and a concrete floor 2½ feet thick was built on the

walls and monolithic with them forming a deck closing the shaft and with a central 36-inch material shaft hole and a 36-inch manlock hole, two 8-inch holes for air pipes, four 4-inch holes for blow lines, two 6-inch holes for high pressure air pipes, and an 8-inch concrete chute hole. The slab was reinforced with 1-inch horizontal and transverse bars 6 and 12 inches

apart. After the concrete was sufficiently set, air locks and pipes were installed, pneumatic pressure was applied and the remainder of the shaft to the final depth of 27 feet was excavated by pick and shovel work, the sides being sheeted with 3 x 8-inch horizontal boards with short spacers nailed to the end to separate the successive courses 2 inches. A 2 x 4-inch vertical strip 8 inches long was nailed to the inner surface of each board 3 inches from the end on the 13 foot 8 inch sides of the shaft, to give shoulders affording bearing for the boards on the 15 foot 2 inch sides, each of which was made in two parts with a butt joint at the centre.

As the excavation proceeded the sides of the pit were lined with concrete 12 inches thick, reinforced with vertical and horizontal ¾-inch bars near the inner surface. This concrete, deposited in successive courses of convenient height to underpin the upper parts of the wall, was anchored to the latter by vertical dowels left projecting from the



CONCRETE MIXING PLANT AND AIR LOCK AT TOP OF SHAFT.

lower side of each successive course and was laid up against the permanent exterior wooden sheeting.

The bottom of the pit was covered with a reinforced concrete floor 12 inches thick bounded to the walls by the vertical reinforcement bars in the latter. Circular holes 7 feet 1 inch in diameter and concentric with the tunnel were molded in opposite sides of the shaft lining, but the exterior wooden lagging was uninterrupted and continuous outside of them.

INSTALLATION OF PLANT.

In the operating house near the top of the shaft, there are installed three Ingersoll air compressors each with a combined capacity of 3,600 feet of free air per minute, which are operated with steam from three locomotive type boilers of 310 h. p. combined capacity. One of the machines suffices to maintain the required air pressure of 5 to 10 pounds in the headings and the other is held constantly in reserve, ready for instant use in case of necessity. At present no high pressure air is required, but either machine can be operated to provide it for running pneumatic tools or other purposes.

Concrete is mixed in a Ransome mixer of $\frac{3}{4}$ -yard capacity, and the derrick is operated by a two-drum American hoisting engine.

The airlock on the material shaft is fitted with an umbrella cover, the domed top plate of which is gasketed and held by a number of pivoted bolts working through slots, that are easily released to provide for the passage of the bucket. The bucket is attached to a hoisting line passing through a stuffing box in the domed cover and thus permits rapid operation of the lock. The manlock is of the ordinary description with hinged doors and, on account of the low pressure, it is operated as rapidly as the air can be delivered or exhausted so that it only requires 2 or 3 minutes to enter or leave the tunnel.

TUNNEL EXCAVATION.

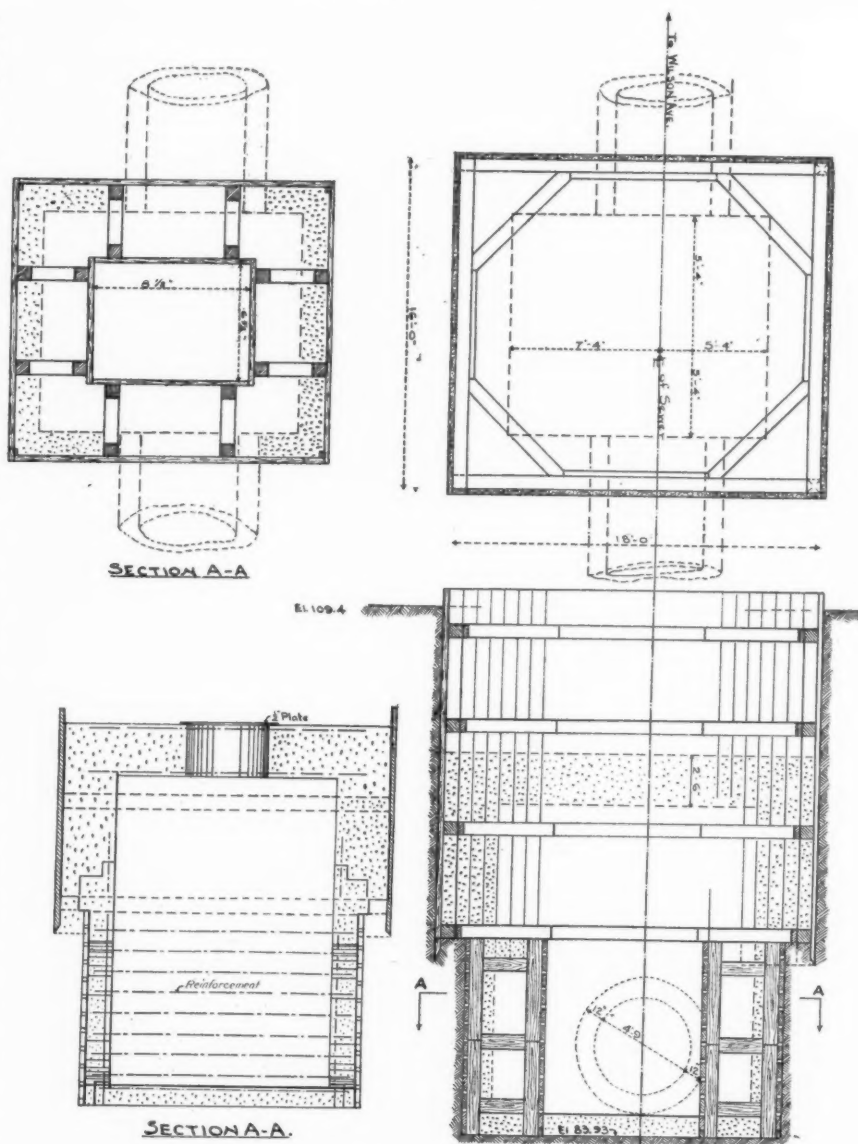
Drifts were started simultaneously in both directions from opposite sides of the shaft where the wooden lagging was cut through and the earth and clay removed with picks and loaded into $\frac{1}{2}$ -yard rotary steel dump cars running on an 18-inch gauge service track with 12-pound rails laid on the invert of the finished tunnel. At the foot of the shaft the cars dump into the circular bucket in which the soil is hauled to the surface. On account of the very small dimensions of

the tunnel the corners of the standard steel bodies of the dump cars had to be rounded off in order to give clearance for revolving them.

The heading is excavated full size, with the upper part carried a little in advance of the lower part and the neat excavation widened a little at the haunches providing there a horizontal shelf on which are seated the ends of the segmental courses of steel roof plate.

Although the earth is very solid and stands up well with vertical faces when first cut, the contractors are unwilling to take any chances and support the roof close up to the heading with the segmental arch plates provided for in the contract and there designated as permanent reinforcement.

These plates, furnished by the Blaw-Knox Co., correspond exactly to the regular cast iron segments of permanent tunnel linings used in shield driven circular tunnels. They are, however, made of very thin pressed sheet metal with flanges on all sides for bolted connections. They have a uniform width of 12 inches and are about 3 feet long and weigh only about 15 pounds each.



SHAFT SHEETING, CONCRETE LINING, BRACING AND HORIZONTAL CONCRETE DIAPHRAGM FOR AIR LOCK.

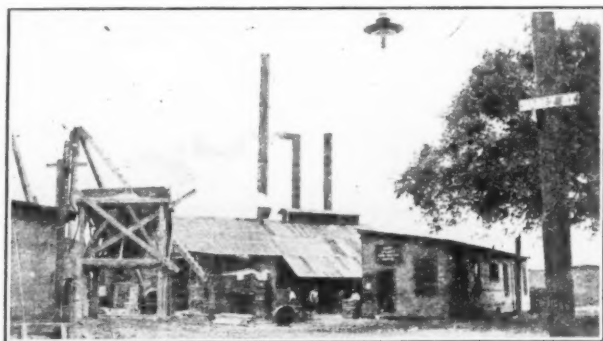
The contract provides for the use of these plates if necessary around the entire arch and to a point 1 foot below the springing line on both sides, but where the ground is satisfactory, they are omitted below the haunches.

The segments are assembled from the crown downward on both sides, the centre ones being temporarily supported until the skew back pieces are wedged up on the ledges, by cantilever beams jacked up against the last completed section of arch plates.

CONCRETING.

In order to expedite the delivery of concrete to the headings and to avoid obstructing the very limited space at the foot of the shaft in the tunnel, the concrete is mixed on the surface and delivered from the mixer to a Ransome-Caniff pneumatic machine installed in the upper part of the shaft which acts as an air lock and from which the concrete is rapidly forced through the 8-inch delivery pipe to the steel dump cars, already described, at the foot of the shaft.

The concreting is kept as close as possible to the face of the heading where there are installed



SHAFT HEAD HOUSE, AIR COMPRESSOR PLANT AND CONTRACTOR'S SHOPS.

two 5-foot sections of standard Blaw steel collapsible forms with removable upper lagging.

The concrete is dumped from the cars into the lower parts of the forms and shoveled from the cars into the upper parts. The work is carried on continuously with three 8-hour, 17-man shifts per day in each heading, each averaging an advance of 5 feet per shift, or 30 feet in 24 hours.

In each excavating gang there is one foreman at \$7.50 per day, two miners at \$6 each per day, and 4 muckers at \$5.50 each per day.

So far very little water has been encountered in one heading and not much in the other, and the soil has been good and safe except in one heading where a bed of quicksand has been encountered in the bottom that at present comes up about a foot above the invert but had occasioned little trouble.

The Snoqualmie Falls Lumber Co., Washington, occasionally does field work worthy of a contractor for engineering construction when by means of its hoisting engines and equipment of wire hauling ropes and guides, it moves, in a vertical position, trees 200 feet high and 8 feet in diameter that are cut off clear of the stumps and hauled from 10 to 100 feet horizontally before they are lowered to lie on the surface of the ground.

National Department of Public Works

Professor George F. Swain has outlined as follows some of the principal advantages which will be secured by Senate Bill No. 2232 for the creation of a national department of public works:

1. It will conduce to efficiency by co-ordinating in one department and under one head the administration of all works built and operated for the use of the public.

2. It will conduce to economy. There will be either less expenditure or greater result obtained for each dollar expended.

3. It will eliminate rivalry and competition for appropriations between different departments.

4. It will provide a complete organization which can, if necessity requires, be turned to war work or any other emergency.

5. It will provide an organization equipped to do technical work for other departments at their request.

6. It will result in a standardization of specifications and contracts.

7. It will, therefore, eliminate much of the risk and delay which a contractor now has to face in taking a government contract.

8. It will simplify the purchase of materials, machinery, etc., and conduce to economy in such purchases.

9. It will help to bring about the establishment of a budget system.

10. It will serve as a regulator of our national industries, because the Department can speed up its work in dull times and slow down in boom times.

11. It will put us in line with other civilized countries most of which have a Department of Public Works, under a cabinet minister.

12. It will provide means for giving to the officers of the Corps of Engineers of the United States Army a broader experience in construction work than they now have and covering lines more specially connected with the work which they have to do in war.

13. It will help to prove to the world that a democracy can be administered economically and efficiently.

Car Shortage Relieved by Motor Trucks

The car shortage which is beginning to be seriously felt in many parts of the country has already had its effect upon the sales of motor trucks. In August the sales of Mack Trucks alone increased 64 per cent over those for July, and the sales for September continue at the same high rate.

R. E. Fulton, vice-president of the International Motor Company, said: "There is just one solution to our present industrial troubles, and that is the production of necessary supplies on the largest scale possible, and their prompt, thorough and efficient distribution. Through its transportation efficiency and economy, the motor truck is giving material aid in advancing both production and distribution. Reliance on motor trucks will become more imperative with the coming of cold and unfavorable weather."

Mechanical Road Construction

Rapid progress was made in the construction of 20 miles of an 18-foot concrete highway, by the installation of an abundant and well selected mechanical equipment that eliminated a large percentage of hand work and was operated by a well organized force working systematically to a definite schedule that secured a high degree of efficiency. All materials were delivered by rail to elevated storage bins, shifted as the work progressed, and then distributed over service tracks taken up and relaid to correspond with the working progress. Two grading plants and two concreting plants simultaneously completed pairs of sections into which the road was divided.

About 20½ miles of the 18-foot concrete surface of the Lincoln Highway between DeKalb and Geneva, Ill., has been constructed at the rate of nearly 1,000 linear feet per day by contractor J. O. Heyworth, Chicago.

EXCAVATING AND GRADING.

The road was divided into five 4-mile sections consecutively numbered 1, 2, 3, 4, and 5. The new road replaces an old gravel surface road, all of the top of which was removed with cuts made to a maximum depth of 1½ feet and averaging 3,000 yards per mile. The work was done with a single grading outfit and two subgrading and concreting outfits. The former was installed at the end of the line and graded all of section 1 and a little of section 2 before the concreting plants were installed at the extremities of sections 1 and 2, and thereafter kept about 3 miles in advance of the concreting.

A scarifier was used to loosen the most refractory parts of the old surface and the material was dug out and removed chiefly by an elevating grader hauled by 12 horses and loaded into dump wagons that distributed the material along the shoulders. Drag scrapers were provided for light dressing and moving the material for short distances. The men operating the machines and wagons were boarded in a portable camp moved every two miles so that the men had to walk a maximum distance of only one mile in each direction from the camp. The camp was provided with a kitchen, a mess wagon and a bunk tent.

After the grading had been completed, the subgrading equipments which accompanied the concreting machinery started at the first end of sections 1 and 2 and after completing them simultaneously were transferred to the first ends of sections 3 and 4, and afterwards to the middle of section 5, where they operated simultaneously in both directions.

The road bed and ditches were shaped to approximate cross-section by a blade scraper hauled by a steam roller that afterwards finished them accurately enough for the steel side forms to be set true to line and grade. A subgrade finishing machine, rolling on the steel side forms, was hauled along the line by the roller, and after trimming the surface down as closely as possible, was followed by the roller alone, which finished the subgrade ready to receive the concrete.

STORAGE AND DISTRIBUTION.

Sand, gravel and bulk cement were delivered on railroad sidings laid successively to the three stor-

age points, the first and second of which were on the main line of the Chicago and North Western Railway while the third was located at a considerable distance from it transversely.

The first shortage was located close to the railroad tracks and about half a mile from the highway opposite the point where sections 1 and 2 joined. The second storage was similarly located on the opposite side of the highway where sections 3 and 4 joined, and the third storage was located in the middle of section 5, close to the highway, but more remote from the railroad, which at that point is oblique to the highway. Two locomotive cranes operating on a track alongside the railroad track unloaded the contents of the sand and gravel cars with a clamshell bucket, delivering them to open flat-bottom storage bins, or, when there was an excess of material above daily requirements, delivered it to storage piles on the surface of the ground alongside whence the material could be reclaimed and filled into the storage bins if the railroad supply was interrupted. The cement was delivered in flat bottom gondola cars which, like the cement bins, were protected by tarpaulins.

Attached to the bottom of each cement bin, over the center lines of the industrial tracks that passed under it, there were several 15 x 15-inch vertical steel hoppers with a 6 x 6-inch open bottom, projecting from the bin bottom and into the top of the chute so as to concentrate the delivery of cement to the center part of the chute. Vertical pipes, open at the top and bottom, passed through the sides of the hopper and extended above the top of the bin to equalize the atmospheric pressure in the chute when the latter was filled with cement.

The flow through the hopper was controlled by a horizontal sliding steel gate closing against a rubber packing, which prevented leakage. About 2 feet below this gate there was a second similar gate closing the lower end of the chute. The two gates were simultaneously operated by a lever so arranged that if either one was opened, the other was closed, and this simultaneous operation delivered always a fixed quantity of cement from the chute, sufficient for one batch of concrete.

SERVICE TRACKS.

There were provided five miles of 24-inch industrial track in 15-foot sections which was laid under the bin and passed thence to the highway where it branched 90 degrees in each direction to follow parallel with the highway. One branch was

at first extended to the beginning of section 1 and the other branch extended only a short distance on section 2 from its beginning adjacent to section 1. Materials were delivered over these branches to the mixers installed opposite their extremities and as fast as the concreting advanced on section 1, the track was taken up alongside the completed portion, loaded on cars, and shifted to a position in advance of the concreting on section 2, where the track was relaid and the process continued until most of the track paralleling section 1 had been laid on section 2.

When sections 1 and 2 had been completed, the storage bins were knocked down, transferred, and reerected opposite the junction of sections 3 and 4 and the industrial track shifted to lead to the beginnings of these sections; and finally, the shifting operations were repeated and the same program carried out for the third position of the storage bins.

Sidings long enough to accommodate a locomotive and train of cars were provided on the industrial track close to the highway, between this position and the storage bin, and adjacent to the concrete plants wherever the latter were located. Besides these a fifth siding was provided at the junction of the adjacent sections where a blacksmith and repair shop was located.

CONCRETING.

Each of the concrete mixers was a four-batch machine with caterpillar traction and an elevator charging skip served by a boom which emptied into it the contents of 2x3½x4-foot wooden batch boxes with bottom flap doors controlled by hand-operated latches.

The batch boxes, loaded in pairs on trains of flat cars hauled by locomotives, were provided with gage marks indicating the required amount of sand, which was first drawn into each when the cars were run under the storage bins. The cars and boxes were then hauled to position under the cement bin and one batch of cement was delivered to each, after which the cars were hauled under the stone bins and filled to the top with stone. Five trains were kept constantly in service, one of them always being loaded at the storage bins while two were in transit and two more were being unloaded at the mixers.

Each concreting gang consisted of 10 men who unloaded the trains, operated the mixers, spread the concrete and operated one mechanical tamping and finishing machine. Two of the men covered the slab with canvas and built dikes for its pondage. With this equipment a progress of about 450 linear feet per day was made by each concrete mixer.

Highway Improvement Rewarded

The Pennsylvania State appropriation of \$1,000,000 has been apportioned among the various counties according to the miles of roads in townships of the second class. This mileage is compiled from map surveys made by the township division of the State Highway Department. There is a total of 74,875 miles of township roads in townships of the second class. The distribution is at the rate of \$13.35 per mile. Second class townships are not entitled to any part of this reward until they comply with the State law governing the new sys-

tem. Lancaster County leads with the maximum of 2,567 miles of road improvement for which the reward amounted to \$34,383.80.

A Versatile Paving Mixer

The DuPont Engineering Company, of Detroit, Michigan, used a 1919 Model Smith Paver more than a year for a large variety of services in connection with the construction of the new plant of the Cadillac Motors Company at Detroit, without any breakdown or need of a repair part.

This paver, equipped with a swivel chute, poured all the many column footings, each 8 feet wide, 8 feet long and approximately 8 feet deep. The paver was placed between the rows and poured first on one side and then on the other side by merely swinging the chute, advancing easily and rapidly by its own traction.

After the paver had completed this work it was driven under its own power to another spot where it poured the walls of one of a large tunnel.

It was then taken into the building and was used for grouting in the successive floors and for pouring all of the floor slabs.

It was taken from one story to the next by a crane which hooked onto two cables wrapped around the machine.

Care of Wire Ropes

Wire rope should be carefully unwound from the reel so as to avoid kinks that are likely to injure it very much. The reel should either be placed on an improvised turntable and the rope pulled off, or it should be rolled on the ground leaving the rope in a long straight line. When new rope is led over grooves in old sheaves or drums the latter should be carefully examined to make sure that they have not worn too small at the bottom, in which case they will seriously injure the rope. The rope should be well greased when first received and should be lubricated from time to time.

Multiple Ditching Plant

Excellent results were obtained in excavating right of way ditches with machinery on a very busy railroad line where there were very short intervals between trains when the machines could work.

A train was made up consisting of three pairs of dump cars separated by three flat cars on each of which was mounted an American ditcher machine. The train was hauled by a locomotive that pulled it on to the main line in short intervals between regular trains and permitted the ditchers to work with maximum rapidity filling the adjacent dump cars.

In this way the work was not only done at least three times as rapidly as by the ordinary method of handling a single ditching machine as a separate unit, but the average cost of the latter operation, 18 cents per yard was reduced to 13 cents thus effecting a saving of more than 27 per cent. in the direct cost besides expediting the work and reducing loss through delays. For emergency work it is evident that when several machines are available they can be handled to advantage in batteries.

LEGAL NOTES

A Summary and Notes of Recent Decisions—

Separate Bridge Bids—7.

In *Clark vs. Beadle County*, 173 N. W. R., a contract had been awarded by the county to a bridge company for the construction of six bridges, for which the bridge company had bid a lump sum. The Statute required a separate bid for each bridge to be built. The plaintiff, who himself had bid upon the contract, brought an action as a taxpayer to enjoin the county from paying any money under the contract. The action was not brought until more than two months after awarding of the contract and until after the bridge company had performed much of the work. The Supreme Court held that the plaintiff who knew of the awarding of the contract, was estopped from maintaining such an action. (Supreme Court of South Dakota, July 22nd, 1919.)

Irregularity Does Not Void Authorized Sewer Contract.

In *Stickel Lumber Company vs. City of Kearney*, 173 N. W. R., 595, it appeared that a special election had been called for the submission to the electors of a proposition to vote certain bonds, the proceeds of which were to be used to pay for a sewerage system. In anticipation of a favorable result of the election, the City Engineer purchased certain pipe and caused it to be laid. At the election the proposition to vote bonds was defeated. A bill for the pipe was allowed by the city council and a warrant ordered to be drawn, when an appeal was taken to the District Court by an intervening taxpayer. The Supreme Court of Nebraska held that the city was liable, saying in part:

"Even though the statutory requirements as to the making of a contract have not been carried out, if the city authorities are vested with general authority to do the act for the performance of which the materials are supplied and there are no elements of other than fair dealing shown and the city elects to keep the property, there may still be a recovery for the reasonable value of the same . . . In the case at bar, by the Statute then existing, the Mayor and Council were given the power to change the grade of the street and to award contracts for perfecting such change. Where the Municipal Corporation has the power to make a contract but fails to follow the procedure laid down by the law as to the making of the contract it cannot properly be said to be ultra vires and void, but is merely irregular."

Retained Payment for Pavement.

Hagaman vs. City of Rochester, 185 A. D. 161, Supreme Court, N. Y., Appellate Division, Fourth Department. The syllabus follows: "Where in actions by the transferee of certain funds representing moneys earned by contractors for the construction of pavements and retained by the authorities of the defendant city as security for the fulfillment of the covenants of the contractors to maintain and keep in repair the pavements for the period of ten years, that period having expired, the defendant alleged that the right to the

funds had been abandoned and that the moneys, except a small amount which had been paid to the plaintiff, had been applied to the payment of expenses incurred by the defendant in the work of maintenance of the pavements made necessary by the default of the contractors, and under the provisions of the contracts the contractors could only be put in default for failure to make repairs by neglect to make them after written notices by the commissioner of public works were served upon them, either personally or by leaving the same at their places of business or residences or with their agents in charge of the work, it was error for the court to instruct the jury that even though no notices were given of the need of repairs to the pavements, and no notices were given requiring the contractors to repair the same, still by the terms of the contracts the contractors were required to keep the pavements in repair so that if repairs were needed and not made by the contractors, but were made by the city authorities or under their direction, the expenses of such repairs could be taken from the guaranty funds.

"It was also error for the court to permit the jury to find that letters mailed to the contractors if received by those to whom they were addressed, constituted a substantial compliance with the contract for the service of notices requiring repairs, as the members of the firms of contractors were men well known in the defendant city and should at all times easily have been found.

"The letter and spirit of the contract required strict adherence to the prescribed method of the service of notices, and such method was a condition precedent to the right of the city to make repairs at the expense of the contractors.

"Letters calling for repairs to a pavement addressed to a member of the contracting firm, individually, even though served personally, would not be sufficient under the contract to put the firm in default."

Repudiation of Sub-Contract.

Re:—*Interstate Const. Co., Ltd., vs. United States Fidelity & Guaranty Co.* Supreme Court of Michigan, P. 173—NWR 174. Where a contractor mailed a subcontract, and sent the subcontractor a telegram relating to the subcontract on the same day, the subcontract and telegram were parts of a single transaction and both might be examined for the purpose of ascertaining the agreement of the parties.

Where it was contemplated that work under the subcontract was to commence within a reasonable time after a certain date, the subcontractor having elected to repudiate the subcontract because of the contractor's unreasonable delay in having the piling and foundation in proper shape for commencement of the work by the subcontractor, could show, in the contractor's actions for breach of subcontract, that the changed labor conditions occasioned by the contractor's unwarranted delay would have imposed an extraordinary and unwarranted burden on the subcontractor.

Herring, W. E., has resigned as industrial manager of the Puget Sound Traction Light & Power Co. and has joined the engineering staff of Stone & Webster.

NEWS OF THE SOCIETIES

March 24-25. NATIONAL WHOLESALE LUMBER DEALERS ASSOCIATION, Washington, D. C. Secretary, 66 Broadway, New York.

March 24-25. NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. The first annual meeting at Chicago. Executive Secretary, John C. Frazee, Drexel Building, Philadelphia, Pa.

March 24-26. SOCIETY OF INDUSTRIAL ENGINEERS, Bellevue-Stratford Hotel, Philadelphia. Secretary, 327 South La Salle St., Chicago.

March 25. NORTH CAROLINA PINE ASSOCIATION, Norfolk, Va. Secretary, Norfolk, Va.

April 12-17. UNITED STATES GOOD ROADS ASSOCIATION. Eighth Annual Convention, Hot Springs, Ark. Director-General, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

April 16-17. BANKHEAD NATIONAL HIGHWAY ASSOCIATION. Fourth Annual Convention, Hot Springs, Ark. Secretary, J. A. Rountree, 1021 Brown-Marx Building, Birmingham, Ala.

May 10-11. AMERICAN ASSOCIATION OF ENGINEERS. Sixth Annual Convention, St. Louis, Mo. Secretary, C. E. Drayer, 63 East Adams Street, Chicago.

May 13-14-15. LEAGUE OF TEXAS MUNICIPALITIES. The eighth annual convention will be held at Dallas, Tex. Secretary-Treasurer, Frank M. Stewart, University of Texas, Austin, Texas.

May 18-21. NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Pasadena, Cal. Acting Secretary, S. A. Sewall, 29 West 39th Street, New York City.

June 22. JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE. Next meeting at Asbury Park. Secretary-treasurer, D. A. Abrams, Lewis Institute, Chicago.

June 21-25. AMERICAN WATER WORKS ASSOCIATION. Annual meeting, Montreal, Canada. Secretary, John M. Diven, 153 West 71st Street, New York City.

Oct. 4-8. AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, St. Louis, Mo. Secretary, Charles Carroll Brown, 404 Lincoln Avenue, Valparaiso, Ind.

National Federation of Construction Industries.

At the first annual meeting, Chicago, March 24-26, the Member Associations are requested: (1) To confer upon their delegates to the annual meeting power to act in the adoption of amendments to the By-laws; (2) To submit to the Board of Directors, through the Secretary, not later than March 15, 1920, any desired amendments to the proposed By-Laws.

Associations which are not members of the Federation are requested: (1) To send representatives to the annual meeting with power to make application for membership in the name of their association; (2) To furnish credentials conferring upon their representatives the power of delegates as soon as their association shall have been elected to membership.

Individual members are requested to submit to the Board of Directors of the Federation, through the Secretary, not later than March 15, 1920, any desired amendments to the proposed By-Laws.

The Directors of the Federation extend a cordial invitation to all Associations, both member and non-member, having to do in any way with the construction industry, to have present at the annual meeting their secretary-managers, district managers, legal counsels, engineers, traffic managers, publicists, statisticians and other members of their staff.

American Water Works Association

The New York section of the Association has started a drive to increase its membership sufficiently to win the Hill Cup before the close of the contest next June, and has sent out a large number of membership applications. Additional applications may be had from J. M. Diven, secretary, 153 W. 71st Street, New York City.

The Hill Cup is awarded to the section showing the greatest percentage increase in membership during the year. It is now held by the Minnesota Section and is still in the ring, due to their generous offer to have the contest continued although they have won it for three years and could claim permanent possession. New York Section has to date the same percentage growth this year as the Minnesota Section.

American Lumber Association.

Formation of the American Lumber Association by leading wholesale lumber dealers of the United States, is declared to be the greatest lumber organization in the world in scope, capital and business represented. The new association will begin operations the latter part of this month with headquarters in Chicago. Its membership comprises wholesale lumber dealers in all important American cities with selling connections in all parts of the world.

L. Germain, Jr., head of a large concern that bears his name in Pittsburgh, Pa., has been selected as president, and L. R. Putnam, of New Orleans, who now resigns as director of advertising and trade extension for the Southern Pine Association, has been appointed manager. Mr. Germain also is president of the National Bureau of Wholesale Lumber Distributors, which was formed to serve the lumber needs of the United States government during the war.

According to Mr. Putman, who made the announcement of the formation of the wholesalers' association, the same style of organization that handled the lumber situation for Uncle Sam during the war, in the new association is enlarged in scope to meet the demands of world trade and to give the lumber consumer the same benefits that were enjoyed by the government in war times.

In the official announcement the purposes of the association are stated to be to standardize the buying and distribution of the enormous volume of wholesale lumber business; to enforce a rigid code of business ethics among lumber wholesalers; to systematize distribution so that no part of the market shall be crying vainly for lumber while other parts of the market are glutted, and to devise means for eliminating the present enormous wastage in the lumber business.

"The American Lumber Association will have nothing to do with the naming of prices on lumber, which will be fixed by the manufacturers as at present, but it is designed to perform a service for the world in peace that was performed for the nation in war by the National Bureau of Wholesale Lumber Distributors." Further purposes and plans as set forth in the announcement are as follows:

"Marked reduction in the cost of handling America's lumber output, which a recent nation-wide survey has shown to cost manufacturers more than \$50,000,000 annually is expected to result from the work of the new association. In the United States today there are in excess of 40,000 saw mills in operation, each mill maintaining its own selling organization and having its own representative in the field. With the creation of a central sales force by the new association much of this huge annual expense will be eliminated from America's lumber business and efficiency will be increased. The central offices in Chicago will act as a lumber clearing house for the country's leading wholesalers.

Chamber of Commerce of the United States.

The eighth annual meeting at Atlantic City, April 27 to 29, will be an Increased Production Convention. The general subject of increased production has been divided up in the program for the convention into sub-subjects. The first to be taken up will be the government in relation to production. Under this heading will be considered anti-trust legislation and taxation.

The second general subject to be taken up will be transportation in relation to production. This will

include both land and water transportation. One of the chief causes of lack of production just now, it has been pointed out, is the general shortage of railroad equipment. One authority estimates that the country is short at least 200,000 box cars and all lines of industry have felt the shortage.

International finance and its relation to world production will be discussed both from the financier's and the businessman's point of view. The chamber has just expressed its willingness to name delegates to an international financial conference under limitations outlined by the Treasury Department. Lack of means of financing European industries is a decided factor in retarding production in many of the countries of Europe.

One general session of the convention will be given over to agriculture in relation to production.

Another important general subject will be the relation of labor to production. This will be approached from both sides, the employes' viewpoint being presented by a representative of the American Federation of Labor and the employer's by a business man.

Besides the general sessions there will be held group meetings, divided as along the great divisions of industry.

Louisiana Engineering Society.

The regular meeting of the Louisiana Engineering Society was held in New Orleans, March 8. Marcel Garsaud, representing a committee from the State Board of Engineering Examiners, introduced a resolution leading to the endorsement of the society of the amendment to Act No. 200, 1914, relative to the practice of civil engineering and surveying in Louisiana.

Drainage Conference.

The Third Annual Drainage Conference of the University of Illinois was held at Urbana, Ill., March 16-18. Drainage officials, owners of low lands, agriculturists, engineers, contractors, attorneys, and business men from all parts of the state were in attendance to discuss the importance of the reclamation of the overflowed lands, and ways and means for accomplishing its reclamation.

Engineering Council.

In December, 1919, Engineering Council created a Military Affairs Committee to consider the relation of engineers to the future military establishment and activities of the United States. The membership comprises civilians as well as ex-officers of many of the services of

the Army and Navy, men of all the important branches of the Profession of Engineering. This committee recommends the training of the entire youth of the nation and the establishment of organized reserves are indispensable provisions for national defense. With an adequate, organized citizen force, so that a minimum of professional soldiers is required, that maximum protection is afforded with a minimum of expense.

Women's Municipal League of the City of New York.

The chairman of the special committee on streets, Mrs. Julius Henry Cohen has addressed a letter to Mayor Hylan protesting vigorously against the present antiquated methods and machinery of the Department of Street Cleaning which, she contends, should be entirely motorized and, in view of the great labor shortage, should be supplied with more automobile sweeping and flushing machines, more snow plows, and more machines to propel the plows. She also pleads for the conservation of the idle garbage disposal plants at Barren Island and on Staten Island and suggests that garbage reduction plants be installed in the different boroughs for the immediate disposal of the contents of dump carts and the reduction of hauling expenses.

Standard Engineering Salaries Recommended.

The Twin City Chapter of the American Association of Engineers has submitted a compensation report to the city of Minneapolis which contains recommended salaries for all grades of engineers employed by the city. The recommended salary for the city engineers vary from \$7,500 to \$15,000 per annum, that of the assistant city engineer from \$5,000 to \$7,500. Sewer engineer, bridge engineer and engineers of construction, streets, etc., are recommended for salaries ranging from \$3,000 to \$5,000 per annum. The range for assistant is from \$2,400 to \$3,600.

PERSONALS

Gregory, Charles E., deputy chief engineer North Jersey Water Supply Commission, died Feb. 21.

White, Edward A., general superintendent of the White Paving Co., Chicago, died Feb. 18.

Martin, W. E., treasurer of the H. K. Porter Co., Pittsburgh, died Jan. 12.

Bessey, John M., has been appointed general manager of the Employ-

ers' Mutual Insurance Co., New York.

Wheelin, James E., has been appointed secretary of the Employers' Mutual Insurance Co., New York.

Burbank, George Barker, consulting civil engineer, prominent in Niagara Falls electric power development, died of pneumonia at his home at Niagara Falls, N. Y., Feb. 29.

Shurick, A. T., mining engineer, recently identified with the **Coal Trade Journal** and formerly with **Coal Age**, has become associated with F. C. Thornley & Co., Inc., 31 West Forty-third street, New York. The company designs, constructs and organizes for operation, installations for the mechanical handling of materials. It also acts in a consulting capacity in the valuation and appraisal of properties and preparation of engineering reports.

Simmons, Maj. E. B., has been appointed chief engineer of the Willite R. C. Co., of Indiana with offices at Ft. Wayne, Ind., after April 1st. Maj. Simmons served with the 302nd Engineers, 77th Division and at the time of the armistice was in command of the 2d Bn. in the Argonne.

Reeves, Guy A., has been elected U. P. and general manager of the Willite R. C. Co., of Indiana with offices at Indianapolis and Ft. Wayne, Ind. Mr. Reeves has been connected with the Asphalt Sales Dept. of the Texas Co., for many years.

Howe, Wm., of Chicago, has joined the Willite R. C. Co., of Indiana.

Hull, Noah E., has been appointed city engineer of Kendallville, Ind.

Goldsmith, William, formerly construction engineer with the City of New York, has been made president and general manager of the Riverdale Construction Co., Inc., New York.

Weatherford, J. D., building inspector, Phoenix, Arizona, has resigned to undertake general contracting.

Brillhart, D. H., and Brothers, G. R., have formed the Brillhart-Brothers Co., Inc., engineers and contractors, Bethlehem, Pa.

Turner, George F., has been appointed city engineer, Youngstown, O.

Gilmore, J. H., has entered the firm of Mish & Netherland, engineers and contractors, Pittsburgh.

The Armstrong Engineering Co. has been organized at Taylorsville, Ill., with H. G. Armstrong, R. R. Simpson and Judson Rucker, as members.

Hayes, Harry R., commissioner of public works, Utica, will resign that position to become manager of the Hayes Engineering Service, Utica, specializing in municipal utilities, city planning and engineering valuation.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

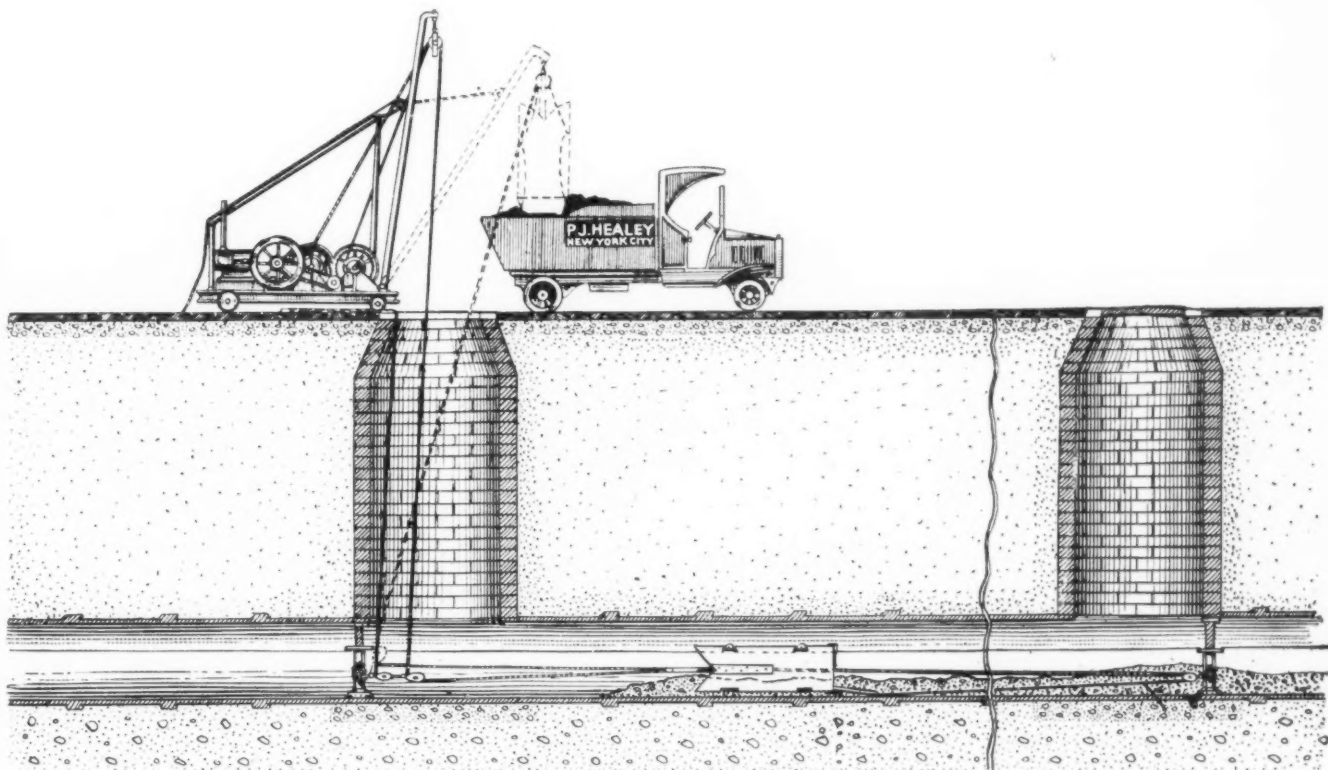
Healey Sewer Cleaning Machine.

Machines invented, manufactured, operated and sold by P. J. Healey are designed to remove sediment and all kinds of obstructions and to thoroughly clean any shape or size of well built sewer, no matter whether it is filled with water or is dry, and without the necessity of men entering the sewer. It thus enables the sewers to be maintained with much greater safety, economy, and efficiency and eliminates the danger, sometimes serious, of working in the very unsanitary conditions encountered in a sewer where often the gas is poisonous and sometimes causes fatal results.

The special bucket is mounted on wheels and provided with friction rollers and with devices for opening or closing both front and rear ends. The front end door when opened, drops to a horizontal position with the lower edge resting on the sewer invert and acting as a shovel or scraper that excavates the sediment or other obstructions in the sewer as the bucket is pulled forward by a line attached to the cutting edge of the scraper, passing through a snatch block secured to a brace installed in the forward manhole and returning to a second snatch block secured to another brace installed at the derrick manhole and

hole, the hauling line is automatically tripped so as to become the hoisting line, and elevate the bucket above the surface where its contents are dumped into the waiting truck. The bucket is lowered and the operation is automatically repeated.

The apparatus is operated by two men and the outfit consists of a $3\frac{1}{2}$ h. p. gasoline engine, double drum hoist, and pipe frame derrick mounted on a truck and equipped with 500 feet of $\frac{3}{4}$ -inch wire cable, 50 feet of release rope, and the necessary braces, shackles, sheave blocks and tool box. When provided with 8-inch, 10-inch, 15-inch, 18-inch



CLEANING MACHINE OPERATING IN PIPE SEWER. BUCKET IN FILLING POSITION.

The apparatus is simple and positive in its operation and consists substantially of a hoisting engine and derrick mounted on a steel truck and easily moved from point to point in the street where it is located at a convenient manhole and operates a special bucket-shovel that it drags from manhole to manhole, excavating and removing all obstructions and hoisting and dumping them to trucks spotted near the derrick.

thence passing to the derrick boom and hoisting drum by which the bucket is hauled from the derrick manhole to the forward manhole, filling itself en route. When filled, the bucket is drawn back to the derrick manhole by means of a line from the hoisting engine passing down the derrick manhole and attached to a bridle connected to the scraper so that tension on it closes the forward end of the bucket.

Arrived at the bottom of the man-

and 22-inch buckets, the equipment is adequate for cleaning all sewers from 8 inches to 6 feet in diameter. For larger size sewers, suitable equipment is furnished. With this machine, an 8-foot sewer in Buffalo was cleaned of $5\frac{1}{2}$ feet of mud, gravel and boulders under 7 feet of water.

Building Erection.

The R. F. Jones Co., Hartford, Conn., has been incorporated with \$50,000 capital stock.

Incineration of Garbage, etc.

The destruction of city refuse including garbage, street sweepings, dead animals and waste of all kinds, except ashes, at temperatures of 1,500 to 2,500 degrees is accomplished by the B. E. E. semi-producer type with waste furnace manufactured by the Chicago Incinerator Co. that is designed to utilize the fuel value of the waste for making steam. An analysis of the subject and descriptions and illustrations of the construction and operation of these furnaces with examples of their application for various purposes are given in a small pamphlet recently issued by the manufacturers.

Adams Road Machinery.

The road building and maintenance machinery manufactured by J. B. Adams & Co. and described in general catalog No. 20, which illustrates a brief history of road graders, the special advantages of the Adams leaning wheel graders that have a toggle joint axle attachment, adjustable in proportion to the amount of the load to prevent side slipping, reduce friction, offset lateral earth pressure and move the maximum amount of dirt with the least power.

It also illustrates graders with blades of from 6 to 12 feet long with scarifier attachment and steerable engine tongue, road maintainers, road patrol scrapers, three-way drags, peerless drags, plows, drag scrapers, fresus scrapers and wheel scrapers.

Lee-Courtenay Pumps.

The Lee Courtenay Company, manufacturer of centrifugal pumping machinery, issues in Bulletin H-4 a catalog, description, illustrations and tables of double suction single stage pumps, and single suction multiple stage pumps suitable to various kinds of continuous and intermittent heavy duty. The bulletin describes the manufacture, design and testing of the pumps, shows various types and sizes installed for different services, and gives tables of their h.p. and efficiency. Bulletin S-5 illustrates pumps, most of them of large size, installed in various parts of the country for important service among which is one designed to deliver 5,000 gal. per min. against a total head of 40 ft. Another one in the Chicago City Water Works is designed to deliver 200 gal. per min. under a 460-ft. head.

Lidgerwood Manufacturing Company

This company will, at the National Marine Exposition to be held in the Grand Central Palace, New York, April 12 to 17, exhibit at booth 43, in charge of E. J. Boynton, two types

of their standard reverse valve cargo winches. They have installed a compressed air outfit, and the winches will be operated, and an actual demonstration made both of the hoisting ability of these winches and the extreme simplicity of their control. Over 6,000 of these winches have been built and installed.

Steam Tables.

The Wheeler Condenser & Engineering Co. announce the publication of the 1920 (fifth) edition of "Steam Tables for Condenser Work." This is the fifth edition. The pressures below atmosphere have been especially calculated for this book by Prof. Marks. The book gives the properties of saturated steam from 29.8 inches vacuum to atmospheric pressure in increments of tenths of an inch. The vacuum in inches of mercury is referred to a 30-inch barometer. A complete table is also given of the properties of saturated steam above atmospheric pressure.

The book tells how to make measurements by means of the mercury column and barometer. It gives constants and tables for making corrections. It gives the correction to be made for relative expansion of mercury and brass scale, etc. It is a very handy book and of a size that can be carried around in the vest pocket.

Birch Pump Valves.

The Birch-Hintz Manufacturing Co. recommends the use of the Birch pump valves to increase valve area and plunger speed and eliminate valve slippage, thereby increasing pump capacity from 10 per cent to 25 per cent.

Trailmobiles.

These are trucks without motors to be hauled behind trucks, passenger cars or tractors. Their use greatly increases the amount of freight one truck driver can move in a given time and enables a lighter, less expensive truck to do more work than a heavy one, or a small passenger car to do as much hauling as two or three teams under certain conditions. The trailmobile chassis is made in long and short lengths both for 1-ton and 1½-ton loads.

United States Civil Service Examinations.

Examinations will be held April 20 for vacancies in the office of the Chief of Transportation Service, War Department, for duty at Washington, D. C., and throughout the United States, as **Marine Engineer**, **Mechanical Engineer** and **Electrical Engineer**. The registers of eligibles will be divided into Grade 1, \$2,400

to \$3,000, and Grade 2, \$3,000 to \$4,000 a year; minimum requirements for each grade being as follows:

Apply for form 2118.

A vacancy in the Engineering Department at large, Florence, Ala., \$4,200 a year.

The duties of this position require general familiarity with the design of all classes of equipment of a steam electric or hydro-electric power plant with detailed knowledge of generators, transformers, switching and control apparatus and transmission lines. The appointee must have sufficient knowledge of architectural engineering to design the structural, heating and other features of buildings, and a working knowledge of hydraulic engineering as applied to turbine design and operation. He must be able to handle efficiently a force of draftsmen and to supervise and direct construction operations. Apply for form 1312.

Examinations will be held March 30 for Junior Construction Engineer, Junior Designing Engineer and Junior Marine Engineer, for the design and construction of wood, steel and concrete vessels, to fill vacancies in the office of the Chief of Transportation Service, War Department, for duty at Washington, D. C., and throughout the United States at \$1,800 to \$2,400 a year. Competitors will not be required to report at any place but must apply for form 2118. Vacancies in positions requiring similar qualifications, at this or higher or lower salaries, will be filled from this examination, unless it is found in the interest of the service to fill any vacancy by reinstatement, transfer, or promotion. Both men and women, if qualified, may enter this examination, but appointing officers have the legal right to specify the sex desired in requesting certification of eligibles.

Applicants should at once apply for forms, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.; the Secretary of the United States Civil Service Board, Customhouse, Boston, Mass., New York, N. Y., New Orleans, La., Honolulu, Hawaii; Post Office, Philadelphia, Pa., Atlanta, Ga., Cincinnati, Ohio, Chicago, Ill., St. Paul, Minn., Seattle, Wash., San Francisco, Calif.; Old Customhouse, St. Louis, Mo.; Administration Building, Balboa Heights, Canal Zone; or to the Chairman of the Porto Rican Civil Service Commission, San Juan, P. R. Applications should be properly executed, excluding the medical certificate, and must be filed with the Civil Service Commission, Washington, D. C., with the material required, prior to the hour of closing business on March 30, 1920.